Regional Science Inquiry

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Contents

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Editorial Note

Within the context of social transition that the challenges due to the fight against the COVID-19 pandemic currently impose, the Regional Science Inquiry Journal (RSIJ), a journal that is published under the aegis of the Hellenic Association of Regional Scientists, launches its thirteenth issue with the awareness that the socioeconomic interactions are submitted to inevitable restrictions showing the potential to change major functionalities in economic systems, regional economy, and economic geography, at all levels of spatial scale. Aiming at freely promoting the academic dialogue about Regional Science worldwide, the topics of this issue of RSIJ, Vol. XIII, (1), 2021, are coordinated in highlighting several modern and importance topics of the subject of Regional research that can thus provide useful insights and support to the conceptualization of the current and upcoming changes that Regional Science faces and is about to face. Such topics focus on the impacts of COVID-19, digital economy, technological change, and technology and economic growth, city amenities, special types of tourism markets, urban connectivity and accessibility, agricultural economy and other aspects of the regional economic systems functionality. The Editor in Chief, Prof. Christos Ap. Ladias, the Editorial Board, and the signatory of this Editorial welcome the reader to the multidisciplinary journey of Regional Science that current issue of RSIJ promises to conduct at its following pages.

In brief, the first paper entitled "A Note on the Use of Amenities to Attract Creative Class Members to a City", by Amitrajeet A. BATABYAL and Seung Jick YOO, studies the decision problem faced by city authorities that seek to attract members of the creative class to their city by providing amenities, shedding light on questions concerning the cost of such amenities.

The second paper entitled "Household impact of the COVID-19 pandemic from a development economics perspective – a review", by Bekhzod EGAMBERDIEV, deals with the ongoing pandemic and provides a systemic assessment of household effects of COVID-19, identifying casual effects of the consequences and research gaps toward the development of proper policies.

The third paper entitled "Digital Economy within the Eurasian Economic Union: Current State and Development Prospects", by Dinara B. KALYBEKOVA, Galiya N. SANSYZBAYEVA, Madina O. KOISHYBAEVA, Tolkyn OSPANBEK, and Aitolkyn B. KULMAGANBETOVA, studies the digital transformation in the socio-economic aspect of the Eurasian Economic Union countries, summarising data on the main directions of digital transformation development, as well as on the existing difficulties in the EAEU countries regarding this dynamic process.

The fourth paper entitled "Modeling logistic enterprise re-location decision by a nested LOGIT model", by Y. Nguyen CAO, develops a model to analyze decisions about the relocation process for logistics enterprise by using discrete choice models, providing interesting insights about location modeling and the important role of spatial interactions in the logistics enterprise relocation decision process.

The fifth paper entitled "Impact of service and e-service quality, price and image on the trust and loyalty of the electronic banking customers", by Ilirjana ZYBERI and Antoneta POLO, measures the impact of service quality, quality of e-service, price factors and their image on the trust and loyalty of customers to banks, aiming to improve the e-banking services and structures in Albania.

The sixth paper entitled "Environmental Cooperation as a Way of Developing Eco-Tourism in the Arctic Region", by Raisa M. IVANOVA, Olga V. SKROBOTOVA, Nadezhda K. MARTYNENKO, Olga S. TAMER, and Anatoly V. KOZLOV, examines a special tourism market and deals with the question of developing infrastructures and proper management model in the Arctic region, within the context of meeting the standards of public administration.

The seventh paper entitled "Population accessibility to rail services. Insights through the lens of territorial cohesion", Daniela- Luminița CONSTANTIN, Corina- Cristiana NASTACĂ, and Emilia GEAMBASU, studies the territorial cohesion in relation to accessibility and provides a comprehensive context of this subject for the cases of Romanian railway system.

The eighth paper entitled "Analysis of urban connectivity effects of the southern federal district", by Inna MANAEVA and Anna TKACHEVA, studies the effects of urban connectivity in territorial space by using three different indicators, focusing on the cities of the Russian Southern Federal District, where the type (direct and reverse) and the strength of inter-territorial relations are revealed.

The ninth paper entitled "Technologization processes and social and economic growth: modeling the impact and priorities for strengthening the technological competitiveness of the economy", by Taras VASYLTSIV, Olha MULSKA, Volodymyr PANCHENKO, Maryana KOHUT, Volodymyr ZAYCHENKO, and Olha LEVYTSKA, studies integral values of technological competitiveness of the economy for the EU countries and Ukraine and provides insights about the strategic priorities and the collective contractual organizational and institutional system toward "technologization" in the processes of social and economic growth.

The tenth paper entitled "Technological change, technological catch-up and market potential: evidence from the EU regions", by Dimitris KALLIORAS, Nickolaos TZEREMES, Panayiotis TZEREMES, and Maria ADAMAKOU, examines the effect of the market potential to the EU regions' technological change and technological catch-up on the basis of nonparametric frontier analysis and dynamic effects assessment, providing insights useful both for the theoretical and the policy-makers.

The eleventh paper entitled "Total quality management in public sector case study: customs service", by Panagiota DIONYSOPOULOU, Georgios SVARNIAS, and Theodore PAPAILIAS, investigates the context of the New Public Management and the implementation of the principles of the Total Quality Management within the a decision making context, focusing on the case study of the Customs Service in Greece, where weaknesses and the strengths for implementing the Total Quality Management are revealed.

The twelfth paper entitled "Modeling of System Factors of Financial Security of Agricultural Enterprises of Ukraine", by Natalia V. TRUSOVA, Oleksandr S. PRYSTEMSKYI, Oksana V. HRYVKIVSKA, Alina Zh. SAKUN, and Yurii Y. KYRYLOV, examines the systemic factors of financial security of agricultural enterprises of Ukraine, showing that the introduction of systemic factors in the general level of financial security allows increasing the level of financial stability and reliability of agricultural enterprises.

The thirteenth paper entitled "Central Asia: drivers, dynamics and prospects of trade and economic cooperation", by Aliya AKHMET, Zhanar MEDEUBAYEVA, Raikhan TASHTEMKHANOVA, Maira IYEMBEKOVA, and Rauilya AITBAYEVA, applies a cross-national analysis for the condition and expansion of trade and economic cooperation in the Central Asian Region (CAR), highlighting the necessity of developing close diverse ties with neighborhood regions.

The fourteenth paper entitled "Economic security management at the meso-level: methodological and legal approach", by Olga OVCHARENKO, Viktoriia SMIESOVA, Maryna IVANOVA, Nataliia KOVTUN, and Liliya Zolotukhina, assesses the economic security of regions as a basis for making managerial decisions and to substantiate the directions of legal regulation of economic security at the meso-level, where directions of legal regulation of economic security in Ukraine are proposed, aiming at leveling threats to economic security and creating a favorable institutional and economic environment in the depressed Ukrainian regions.

The fifteenth paper entitled "Factors Affecting on Urban Location Choice Decisions of Enterprises", by Y Nguyen CAO, studies the principle motives and preferences influencing the location choice behaviors of individual firms in Tokyo metropolitan area, indicating that for choosing a location, the number of employees is a more important determinant for manufacturers and warehouses than that for retailers and wholesalers.

The sixteenth paper entitled "Diversity or specialization? understanding knowledge spillover mechanisms in china", by Shicong XU, examines the empirical validity of important theories of knowledge spillover in the context of China at a micro-level, using a firm-level panel dataset comprised of publicly traded companies listed in the Shanghai and ShenZhen Stock Exchanges during the 2006-2010 period, showing that the number of patent applications by firms in close geographic proximity has a significant and positive impact on success and that proximity to firms in the same industry reduces innovation, while locating near firms from different industries stimulates innovation.

Finally, the seventeenth paper entitled "The potential impact of COVID-19 on mega energy projects and LNG shipping infrastructure; the case of EASTMED pipeline", by Antonios STRATAKIS and Theodore PELAGIDIS, examines the potential impact of the pandemic on the launching of large scale energy projects in Southeast Mediterranean region, and in particular the construction of EastMed Pipeline and its examines the conflicted geopolitical interests of regional players such as Greece, Cyprus, Israel, Turkey and Egypt, as well as the role of European Union and the United States in the energy equation of Southeast Mediterranean.

All these interesting works are available in the next pages of the RSIJ with the aim of promoting the academic dialogue in Regional Science.

On behalf of the Editor-in-Chief and the Editorial Board
Dimitrios Tsiotas, Ph.D. – RSI J.

<u>Articles</u>

A NOTE ON THE USE OF AMENITIES TO ATTRACT CREATIVE CLASS MEMBERS TO A CITY [1]

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Abstract

We study the decision problem faced by a city authority (CA) who seeks to attract members of the creative class to his city by providing amenities. Creative class members care about their own incomes and about the amenities that the city provides. We construct a stylized model of this interaction and shed light on three questions. First, we determine how much additional income must be paid to a representative creative class member to maintain her utility if amenities are withdrawn. Second, we compute the cost of generating amenity benefits that equal a specific fraction of the representative creative class member's income. Finally, we discuss whether the provision of amenity benefits is a cost-effective way of raising the representative creative class member's utility.

Keywords: Amenity Benefits, City Authority, Cost-Effectiveness, Creative Class, Income
JEL classification: R11, R50

1. Introduction

How does a city authority (CA) ensure that his city flourishes economically in this era of globalization? This salient question has occupied the minds of regional scientists, urban economists, and urban planners for several decades. Even so, it is fair to say that in the last two decades, primarily because of the influential writings of Richard Florida---see Florida (2002, 2003, 2005, 2008, 2014)---on this subject, CAs have begun to place emphasis on establishing *creative* cities by attracting creative people to their cities.

In the Floridian view of economic growth and development, cities and more broadly regions that want to prosper in this era of globalization need to do all they can to attract and retain members of what he calls the *creative class*. The creative class "consists of people who add economic value through their creativity" (Florida, 2002, p. 68). In particular, this class is made up of specialists such as engineers, information technology professionals, lawyers, physicists, university professors, and, noticeably, bohemians such as artists, musicians, and sculptors.

We concentrate on a city in this note and we acknowledge Florida's (2002) basic contention that cities seeking to flourish economically need to attract and retain members of the creative class. Once this is done, the following question arises naturally: "How are cities to do this?" Qian (2010), Van Holm (2014), Dalwai (2016), Smiley *et al.* (2016), Rao and Dai (2017), and Vossen *et al.* (2019) have all shed light on this question by using empirical research to make the point that urban amenities[2] such as art galleries, cafes, parks, and restaurants can be used by a CA to carry out the twin "attract" and "retain" tasks mentioned above.

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[1]

[2]

More generally, an amenity is a desirable or an advantageous feature of either a building or a place such as a city. Amenities help provide comfort, convenience, or enjoyment.

That said, even though there is now a fairly large *empirical* literature on the extent to which amenities matter in different urban settings in attracting and retaining the creative class, to the best of our knowledge, there is virtually *no* theoretical research on whether the provision of amenity benefits in a city is a *cost-effective* way of attracting and retaining the creative class.

Given this lacuna in the literature, our objective in this note is to theoretically study the decision problem faced by a CA who seeks to attract members of the creative class to his city by providing urban amenities. Creative class members in our model care about their own incomes and about the amenities that the CA provides. Section 2.1 constructs a stylized model of this interaction. Section 2.2 determines how much additional income must be paid to a representative creative class member to maintain her utility if amenities are withdrawn. Section 2.3 computes the cost of generating amenity benefits that equal a particular fraction---on which more below---of the representative creative class member's income. Section 2.4 discusses whether the provision of amenity benefits is a cost-effective way of raising the representative creative class member's utility. Finally, section 3 concludes and then suggests two ways in which the research delineated in this note might be extended.

2. The Model

2.1. Preliminaries

We begin by pointing out that the creative class, in general, consists of a variety of professionals such as artists, engineers, medical doctors, sculptors, university professors, and is therefore heterogeneous. That said, as noted by Batabyal and Yoo (2020), a city that is looking to attract members of the creative class is generally *not* looking to attract every possible type of member. Put differently, a city like New York is more likely to be interested in attracting banking and finance professionals and, in contrast, a city like San Francisco is probably more interested in drawing in information technology professionals. In addition, even if a CA wanted to attract multiple types of creative class members to his city, it is unreasonable to think that he would be able to do so by offering a single or even a small number of amenities.

Therefore, to focus our subsequent discussion, we suppose that a CA is looking to attract a specific *subset* of members in the creative class such as artists or bankers. Because these members of the subset are either all artists or all bankers, and so and so forth, we can think of this subset of members as *homogeneous*.[3] Now, consider a city with a CA who is seeking to attract creative class members such as, for instance, bankers, to his city. Because these bankers are all homogeneous, we can work with a representative banker without any loss of generality. As such, suppose that this representative banker derives utility U from her own income I and from the amenities A that the CA provides.

For concreteness, suppose that the amenity offered to the representative banker by the CA is a café. Then, we shall think of A as the *total number* of workers that are employed in all the cafes provided by the CA. Note that this way of conceptualizing the amenity benefit clearly shows the *two* sides of the provision question. The representative banker cares about the total number of cafés that are provided and, *ceteris paribus*, the greater the number of workers the greater is the actual number of cafés that are provided. In contrast, the CA is concerned not just about the number of cafes that he makes available to the representative banker but also about the cost of running these cafés. This latter cost is the total wage bill and this explains why we are interpreting A as the total number of employed café workers.[4]

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[3]

See Batabyal and Beladi (2018) for a discussion of related matters.

[4]

It is also possible to think of A as the total number of workers employed in *multiple* amenities provided by the CA. So, if the total number of amenities provided include one café, one art gallery, and one museum, then A would represent the total number of workers employed in the café, the art gallery, and the museum.

The representative banker's utility is given by the homogeneous of degree one Cobb-Douglas function

$$U = I^{1/2}(1 + A)^{1/2},$$ (1)

With this specification of the utility function, the first question we now answer concerns how much extra income must be paid by the CA to the representative banker to maintain her utility if the amenities (cafés) are withdrawn.

2.2. Additional income

If the CA withdraws the amenity benefits, i.e., the total number of cafes that are on offer then, using equation (1), the representative banker's utility is simply

$$U = \hat{I}^{1/2},$$ (2)

where $\hat{I} = I + \Delta I$ and ΔI is the additional income that is required to compensate the

representative banker for the removal of the amenity benefits from the various cafes.

Let us equate the representative banker's utility with and without the amenity benefits. Using equations (1) and (2), we get

$$I^{1/2}(1 + A)^{1/2} = (I + \Delta I)^{1/2},$$ (3)

Solving equation (3) for the additional income ΔI, we obtain

$$\Delta I = IA,$$ (4)

In words, the additional income that is needed to compensate the representative banker for the loss of her amenity benefits is given by the product of her own income and the total benefit to her from the aggregate employment of all the workers in the different cafes that the CA provides for her. We now proceed to our second task and that is to compute the cost of generating amenity benefits that equal a specific fraction of the representative banker's income.

2.3. Cost of amenity benefits

We begin by supposing that the "specific fraction" of the representative banker's income that we are interested in is $I/2$. We know that A represents the total number of workers that

are employed in the various cafés provided by the CA. To this end, assume that each café worker is paid a wage $w > 0$. Since the value of the amenity benefits must now equal $I/2$, we

deduce that A must solve the equation

$$I/2 = IA,$$ (5)

Solving equation (5) for A we get $A=1/2$. This last finding tells us that the cost we seek equals $w/2$. In words, the cost of generating amenity benefits whose value is one-half the representative banker's income is given by one-half the wage paid to the individual café workers in the city under study. Our third and final task is to discuss whether the provision of amenity benefits is a cost-effective way of raising the representative creative class member's utility.

2.4. Cost-effectiveness of amenity benefits

From the section 2.3 analysis, we know that the CA incurs a cost of $w/2$ to generate an increase in the representative banker's utility that is equivalent to an income increase of $I/2$. Using this line of reasoning, it is clear that the amenity benefits on offer are cost-effective as long as the inequality

$$I > w$$ (6)

holds. In other words, it makes sense for the CA to provide amenities to attract the representative banker to his city as long as this banker's income *exceeds* the wage that is paid to each of the café workers in the city. This concludes our discussion of the use of amenities to attract creative class members to a city.

3. Conclusions

In this note, we analyzed the decision problem faced by a CA who seeks to attract creative class members to his city by providing amenities. Creative class members cared about their own incomes and about the amenities provided by the city. We constructed a stylized model of the interaction between the CA and creative class members and shed light on three questions. First, we determined how much additional income needed to be paid to a representative creative class member to maintain her utility when amenities were withdrawn. Second, we calculated the cost of generating amenity benefits that equaled one-half of the representative creative class member's income. Finally, we discussed whether the provision of amenity benefits was a cost-effective way of raising the representative creative class member's utility.

Here are two possible extensions of the research described in this note. First, it would be interesting to analyze the interaction between a CA and creative class members in a repeated game framework in which the amenities demanded and those provided are the subject of bargaining. Second, it would also be instructive to partition the relevant creative class population into different groups and to then analyze how effective a CA is in attracting these different groups of members to his city with cultural amenities and other policy instruments. Studies that analyze these aspects of the underlying problem will provide additional insights into the nature of the static and the dynamic interactions between creative class members and city authorities.

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HOUSEHOLD IMPACT OF THE COVID-19 PANDEMIC FROM A DEVELOPMENT ECONOMICS PERSPECTIVE – A REVIEW

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Abstract

In terms of the socio-economic crisis, the ravages of a pandemic shock indicate that people from developing countries are likely to be more vulnerable. The same direction of impact could be expected in the case of the COVID-19 pandemic; however, both scale and speed of this pandemic differ from others in the past. Therefore, we can expect causes to be different from those of past crises. Although emerging studies are available, the existing literature offers no systematic analysis of household vulnerability in the prism of development economics. Especially the interlinkages of causes and the relative importance of effects and coping strategies are not yet summarized. Therefore, this study aims to provide a systemic assessment of household effects of COVID-19 and tries to identify casual effects of the consequences, to which it adds policy recommendations. The systematic analysis undertaken in this study is based on a cluster analysis of 150 articles and reports provided in international literature. This study shows that two distinct impacts of the COVID-19 pandemic concern food security and market imbalance, together with socio-economic consequences, which a large number of studies identify as the core of a pandemic. Similarly, risk mitigation strategies such as strengthening farm support, food system resilience, and social protection need to be particularly promoted under COVID-19 conditions. The study also identifies research gaps especially in particularities of health outcomes in different food systems and on different economic development levels.

Keywords: Food security, resilience, pandemic, income, poverty, inequality
JEL classification: Q10, Q11, Q13, Q18

Graphical Abstract:

1. Introduction

Since COVID-19 (CO-corona; VI-virus; and D-disease) was defined as a pandemic, the disease and the resulting restrictions in private and economic realms have led to enormous social and economic changes (Chakraborty and Maity 2020). Due to the epidemiological features of COVID-19, the virus has been spreading ubiquitously. Until effective medication and/or vaccination is developed, the situation is likely to continue in a similar vein for the coming years (Lin et al. 2020). The rapid worldwide spread of COVID-19 therefore required a lockdown policy to delay contagion. Lockdown measures, in the absence of effective medical treatment or vaccination, require a response to protect people in developing countries from increasing penury (Aluga 2020; Djalante et al. 2020). This results in an urgent need to strengthen and diversify such strategies to mitigate the emergence of negative economic and social effects as well as to manage the damage that has been already been experienced (Reis et al. 2020).

To explore the economic effects of COVID-19 quantitatively, a review of historical cases may be of interest. One relevant case, the Spanish flu pandemic in the early 20th century, was

estimated to have cost USD 49.6 trillion (Burns, Van der Mensbrugghe, and Timmer 2012). Another study, focusing on various scenarios for influenza pandemics, confirms that even pandemics considered as mild have had a severe impact on the global economy, and were especially strongly pronounced in developing countries (McKibbin and Sidorenko 2006). The economic impact during the shock of Severe Acute Respiratory Syndrome (SARS) in 2002-2003 was found to have most negatively influenced the demand side of consumption (Siu and Wong 2004; Chou, Kuo, and Peng 2004), and led to behavioral changes of consumers (Lee and McKibbin 2004). Forecasts for the COVID-19 pandemic indicate an approximate 5.2 percent decline in global GDP, paralyzing economic activities in many parts of the world (WB 2020). However, looking at both the global outlook and historical evidence, the consequences of any pandemic are unpredictable (Kilbourne 2004), and the actual impact may differ from predictions.

Multiple recent studies have already tried to study and predict the impact of current lockdown measures on food systems in particular (Savary et al. 2020). This paper aims to provide an overview of existing analyses of the economic and social consequences of COVID-19 across multiple academic disciplines. Due to their strong economic importance in low-income countries, a special focus is given to agricultural and food systems, which are particularly hit by negative consequences. By drawing a comprehensive picture of the current knowledge base, I try to establish a new understanding of the multidisciplinary response to this pandemic. In order to contribute to the policy reforms around COVID-19, this paper will put the current research findings in perspective and provide a discussion on potential mitigation strategies for developing countries.

2.   **Materials and Methodology**

To fully capture the bandwidth of researchers' understanding and interpretation, which plays a significant role in explicating related ideas (Denzin and Lincoln 2008), I conducted a qualitative data analysis supported by the NVivo software tool. This software is recommended for the analysis of large and diverse data sources (Basak 2015). Qualitative studies on nutritional research recognize the reliability of this software (Auld et al. 2007), particularly for high data complexity (Göransson et al. 2007).

Overall, there are 6 steps that I covered in conducting analysis, namely collecting the literature material itself, creating nodes and codes, identifying themes, exploring themes and concepts, developing a system to illustrate nodes, and reporting the findings (Altmann, 2013). In order to conceptualize, each passage in an article was analyzed by highlighting the most relevant parts with the help of the coding option in the software. In this sense, codes are helpful to identify themes in a context (Bernard, Wutich, and Ryan 2016) with the highlighted context being stored in corresponding nodes (Bazeley and Jackson 2013). Thus, I coded similar ideas into corresponding nodes under certain names (Sotiriadou, Brouwers, and Le 2014) only after identifying main ideas from selected journal articles and reports (Jackson and Bazeley 2019). In practice, a qualitative method for policy analysis through conducting systematic content analysis was applied by coding and creating representative nodes (Hall and Steiner 2020; Arslan and Alqatan 2020). In this context, this method allows us to efficiently analyze qualitative data for conceptualization and interpretation (Tseng et al. 2019).

In order to understand the pattern of relationships between pandemic outcomes, I used cluster analysis based on grouping sources and nodes. A salient pattern of relationship was obtained by using the Pearson correlation index (Bazeley and Jackson 2013). Clustering, in research techniques, is the classification of multivariate data derived from grouping objects into classes (Macia 2015), which gives an indication of relationships (Zapata-Sepúlveda, López-Sánchez, and Sánchez-Gómez 2012). More precisely, observed objects or nodes conglomerate, implying that they are co-incidents in their meanings with certain similarities (Segev 2010). In practice, there is some evidence that a systematic literature review through the use of clustering techniques with manually created nodes is useful for building comprehensive models (Amrutha and Geetha 2020; Mayer 2019; Rossolatos 2019). I applied the complete linkage (farthest neighbor) hierarchical clustering algorithm with NVivo and showed the results in a dendrogram (QSR 2020). Pursuant to coding structure in this study, there are a total of more than 30 nodes representing COVID-19 consequences and coping strategies. The nodes are organized hierarchically in their visual illustration (Figure 3), which

is based on depicted nested rectangles of varying sizes. In this case, the size of the rectangle indicates the amount of coding in the nodes (Bazeley and Jackson 2013). Visualizing emerging patterns of nodes is done with the help of project maps (Bazeley and Jackson 2013; QSR 2020). This visualization is helpful to understand developed nodes and their linkages with the articles included in this study.

In detail, findings draw on a database of 150 articles and reports mainly from Springer, Elsevier, Wiley, International Food Policy Research Institute (IFPRI), Food and Agriculture Organization of the United Nations (FAO), and International Labour Organization of the United Nations (ILO) sources. A selection of articles is a collection from between the emergence of COVID-19, more precisely when the Coronavirus was confirmed as a pandemic by the World Health Organization on March 11, 2020 (Cucinotta and Vanelli 2020), and August 10, 2020. For further analysis, 10 main attributes are created to show the proportion of the main messages from the majority of articles included in the study (Figure 1).

3. Analysis and Discussion

By classifying articles and reports based on a general message with corresponding attributes (QSR 2020), this study identified food insecurity, poverty, income loss, and others as main impact areas of COVID-19 (Figure 1).

Figure 1: COVID-19 Consequence Attributes
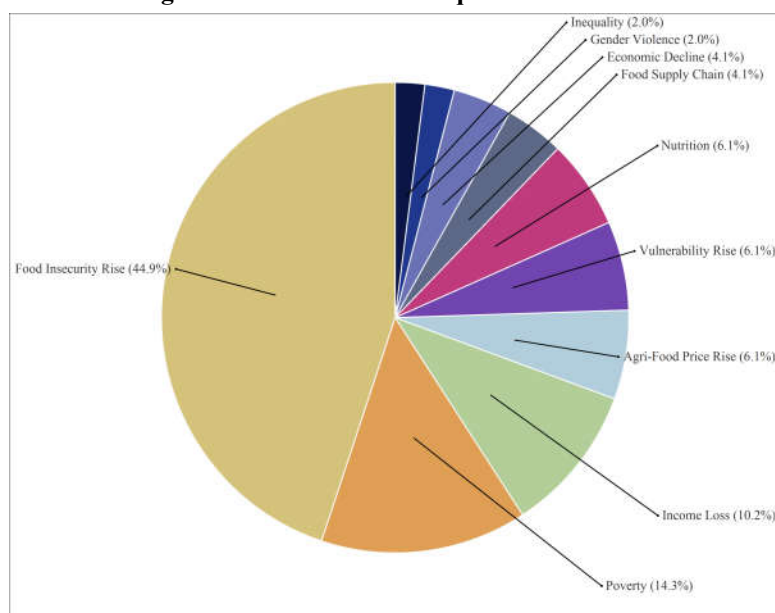
Source: Author's own estimates

Accordingly, more than two fifths of papers in the database indicate that the rise of food insecurity is a large problem in developing countries. This high rate of food security discussions is of course due to the expected twofold increase of 265 million people suffering from acute food insecurity in low-income and middle-income countries (The Lancet Planetary 2020). Meanwhile, COVID-19 poses another challenge to people, which is related to a rising level of poverty. At the moment, we are in a stage of a vicious circle linking the pandemic with rising poverty (Anser et al. 2020) by affecting household resilience (Gillespie 2020). In developing countries, poverty is shown as a large issue that about 14.3 percent of papers from the dataset focus on. In addition to this, a rising market imbalance in the agricultural sector is directly decreasing both production and income sources; therefore, income loss is another one of the most frequently studied issues, with more than one in ten articles in the database citing it. Looking at the economic consequences of the lockdown, this pandemic has driven people to the brink of an income crisis (Buonsenso et al. 2020). Meanwhile, there is growing evidence to suggest that nutritional imbalance, vulnerability, and price rise in agricultural production are becoming other challenges caused by the pandemic. Each of these consequences represents more than 6 percent in this study. Not only has the lockdown policy paralyzed the food system, but this system collapse has also become more gender-sensitive in

many developing countries, putting women in danger (Ragasa and Lambrecht 2020). Correspondingly, the challenges related to economic decline or the food supply chain (representing 4.1 percent each) and rising inequality and gender violence (2 percent each) are also typified as negative consequences by many researchers. In the following sections, the identified consequences are grouped into different nodes, and their clusters lead to an in-depth review of the cascading effects of the socio-economic consequences of COVID-19.

3.1. Food security and market imbalance

By exploring the ramifications of the COVID-19 pandemic, it is becoming more apparent that the ongoing crisis wreaks havoc on structural changes of production and supply chains (Richards and Rickard 2020), leading to growing concerns about food insecurity (Pérez-Escamilla, Cunningham, and Moran 2020). As Figure 2 highlights, food supply and demand imbalance, together with a rise in prices, joining in the first branching diagram, send a strong message about the relationship with food market deterioration. This cluster analysis is based on 48 articles and reports with an emphasis on food system resilience, food security, and malnutrition (Figure 4). In the second clade, one can observe another close connection between food insecurity and malnutrition on one side and food market dysfunction on the other, implying related problems with supply. Generally, these compounding relationships, which are based on 51 article and report sources (Figure 5), infer a market imbalance emphasizing hunger, poverty, or inequality.

Figure 2: Cluster Analysis of Nodes (Pearson's Correlation)
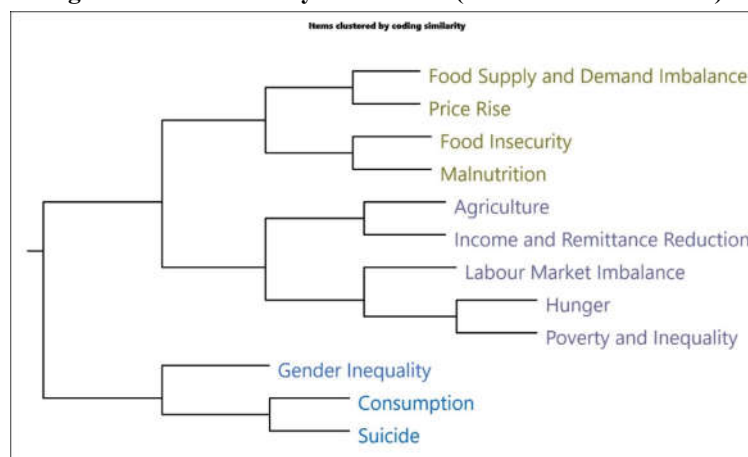
Source: Author's own estimates

From the perspective of the demand side, many countries are struggling with the consequences of the COVID-19 pandemic, because agriculture and food supply chains come under pressure to react to the widespread adoption of physical distancing by the consumers (Gray 2020). Further problems arise from the fact that rising food insecurity is traced to agro-food system failure at the time of the pandemic regime (Gaupp 2020; Mukiibi 2020; Galanakis 2020), indicating an overall vulnerability of food system resilience (Ahmed et al. 2020; Farrell et al. 2020; Chen and Mao 2020). Although there is an uneven influence of the pandemic on supply chains (Reardon, Bellemare, and Zilberman 2020), food supply and demand imbalance impair food system resilience (Béné 2020). Delayed farm operations, labor shortages, and declining farm productivity are considered the main pathways affecting the food production system (Amjath-Babu et al. 2020). This situation has been further exacerbated by the disruption of transportation, through which farmers are suffering from labor shortages (Heck et al. 2020).

The problem discussed above is likely to be more pronounced in global food markets with rising food prices (Heigermoser and Glauben 2020), where it is exacerbating hunger and income imbalances (Laborde, Mamun, and Parent 2020; Gaupp 2020). From this point, a detrimental impact of food supply and demand imbalance on food security problems can be observed in price volatility (Hernandez et al. 2020). Consequently, the outbreak model as a valid instrument in developing countries accounts for very challenging consequences in food security. Meanwhile, the expansion of the COVID-19 crisis sets off some chain reactions

reflected in the nutritional status (Harris et al. 2020; Bhavani and Gopinath 2020). Malnutrition is likely imminent as a result of COVID-19 in countries in which there are limited capacities to deal with ongoing difficulties (Kabir et al. 2020; Zimmerer and de Haan 2020). The case of impairment is also strongly reflected not only in the health status but also in a high prevalence of malnutrition in areas with high poverty (Díaz de León-Martínez et al. 2020). Therefore, many developing countries might be on the brink of cataclysmic malnutrition in the future.

Looking at different channels of the potential economic impact of COVID-19, there are some common problems between short-run and long-run effects. Generally, long-run effects are explained by loss of human capital and infrastructure deterioration, while short-run effects are reflected in wage and income decline and a rise in poverty (Evans and Over 2020). Looking at the second branch of the dendrogram in Figure 2, one can observe a relationship between agriculture and income reduction. However, labor market imbalance does not coincide with this, it has instead its own relationship with another cluster connecting the subject of hunger with poverty and inequality. To sum up, these compound correlations, which are collected from 51 sources (Figure 5), convey a message about supply-side effects. In Figure 5, we can detect a vicious circle which links both the physical and economic access to food. This implies that the ravages of labor market imbalance are reflected in income reduction, leading to more hunger, poverty, and inequality (Savary et al. 2020; Heck et al. 2020). As COVID-19 has been devastatingly affecting economies, many developing countries are grappling with income reduction on both the demand and supply side. If we continue looking at supply-side shocks, there is a high risk explained by labor shortages hampering labor-intensive farms or companies (Hobbs 2020). In turn, the pandemic has been progressively affecting the global workforce (Barrett 2020; Bonet-Morón et al. 2020), aggravating both economic and physical access to food security (Jribi et al. 2020). Under these distortions in production and the supply chain of agriculture, farmers may suffer from difficulties stemming from price changes in production. For the relationship between income-remittance reduction in connection with agriculture and labor market imbalance in Figure 2, we can draw the conclusion that a market imbalance on the supply side in agricultural sectors has a direct impact on earnings. Findings from Myanmar, for example, confirm that people are experiencing an income shock during the pandemic, and that it has eventually affected agricultural input purchases negatively (Goeb, Boughton, and Maredia 2020). At the same time, market imbalance is strongly associated with migrant workers (Diao et al. 2020), which makes the situation more severe by weakening the resilience of migrated people (Abella 2020; Papademetriou and Hooper 2020). Developing countries have witnessed the proliferation of migration, thereby affecting the labor balance (Mukhra, Krishan, and Kanchan 2020). As a general factor from the supply-side, an ongoing shock has a negative impact on employment, thereby decreasing household income (Arndt et al. 2020), which is likely to exacerbate food insecurity (The Lancet Global 2020; Devereux, Béné, and Hoddinott 2020) and hunger (Vaughan 2020). If farmers are confronted with large increases in agricultural input and production prices, their abilities to produce food become limited. Consequently, it may raise a strong backlash as a reaction to the current model of COVID-19 response.

3.2. Socio-economic consequences

Rural areas in developing countries, characterized by higher exposures to COVID-19 due to limited access to health facilities and adequate sanitation, may experience a relatively higher extent of socio-economic difficulties. Therefore, vulnerable people from developing countries are likely to be less resilient to not only COVID-19, but also its projected socio-economic difficulties, which in turn increases inequality or poverty (Figure 2). In addition to inequality and poverty, the main message behind the consequences of COVID-19 in the lower branch of dendrogram is related to socio-economic problems such as inequality, suicide, or changes in consumption patterns (Figure 2). These findings are based on 19 articles and reports mainly related to the social consequences of COVID-19 (Figure 6). Showing a close relationship with socio-economic consequences, it is suggested that COVID-19 is characterized by an increasing suicide rate connected to consumption. Findings indicate that there are confirmed suicide cases from developing countries because of economic difficulties

but not due to COVID-19 itself (Mamun and Ullah 2020; Thakur and Jain 2020; Goyal et al. 2020). Findings showing the relationship between shocks and the level of consumption are nontrivial because some shocks such as climate change or health have long lasting effects on consumption (Dercon, Hoddinott, and Woldehanna 2005; Browning and Crossley 2009; Yilma et al. 2014). The situation in developing countries, where there is a low income and treatment costs are high, might be relatively more severe. For example, estimations indicate that COVID-19 interrupts the level of household consumption in Egypt, showing a household income decrease between 9.0 and 10.6 percent (Breisinger et al. 2020). The imminence of household vulnerability and poverty becomes very high as a consequence of health shocks (Gloede, Menkhoff, and Waibel 2015; Agénor 2004; Dabla-Norris and Bal Gündüz 2014), exacerbating the situation especially in countries without formal health insurance mechanisms (Atake 2018; Gertler and Gruber 2002). Therefore, one can expect household members who are uninsured to be more vulnerable to socio-economic problems, creating extra challenges in designing COVID-19 mitigation strategies.

Although gender inequality is not correlated strongly by a close relationship with other nodes, the situation is more critical in developing countries, indicating a gender-differentiated impact on different dimensions of food security (FAO 2020c; Ragasa and Lambrecht 2020). The eventual consequence might be more detrimental for women, as they are expected to face multiple conflicting roles such as managing their own careers and increased domestic responsibilities (Kantamneni 2020). This has already weakened women's roles in their economic positioning (Kristal and Yaish 2020). Consequently, we can observe a long-lasting impact on discrimination reflected in employment and income inequality of women (Kristal and Yaish 2020; Leung et al. 2020). Rural women, who are considered a key factor in food production and trading in developing countries, are faced with more inequality, disrupting their engagement in the agri-food value chains (FAO 2020c). There is also cause for concern in the fact that gender-based violence is likely to increase during the COVID-19 pandemic (Bellizzi et al. 2020; Gulati and Kelly 2020).

3.3. Future coping strategies

Multi-sector pandemic response is found to be a holistic policy which stems from moving towards an integrated state approach (Fanzo et al. 2020) with a strong focus on the farm-system-for-nutrition approach (Bhavani and Gopinath 2020). We should be aware of the fact that policy approaches for COVID-19 should be fully grounded in strong equality (Hargreaves et al. 2020), as history has already confirmed socio-economic equality to be one of the most important criteria to implement prevention measures successfully (Ribeiro et al. 2018; Hunter 2007). Meanwhile, coping strategies should be based on strengthening resilience specifically of the most vulnerable people (Djalante et al. 2020; Ishiwatari et al. 2020), for which an inclusive approach is the most important (Shammi et al. 2020; Mehtar et al. 2020). To some extent, the evidence from different countries is diverse; however, the main focus should be on the protection of marginalized and vulnerable people. Otherwise, the response might lead to controversy in low and middle-income countries (Kelley et al. 2020; Buheji et al. 2020). Taking this into account, the following coping strategies are suggested for the future, clearly giving alternative solutions to deal with the pandemic and its resulting negative consequences.

3.3.1. Farm support and food system resilience

Overall, the mitigating strategies for both farmer and food system resilience are derived from 25 journal articles and reports (Figure 7). Concurrent household vulnerabilities should be dealt with by programs for strengthening farmers. As the shock becomes relatively more ubiquitous and shows a high risk for farmers, agricultural credits for risk management practices can help farmers to react to market changes (Akhtar et al. 2019). Generally, stimulus packages with agricultural credits cushion negative consequences on production and income.

One of the main policy strategies is to sustain domestic production and farmer's incomes, which should be applied in countries during the COVID-19 crises in order to underpin the agri-food chain and food security (FAO 2020a). Under these circumstances, agricultural credit, being one of several alternative mitigation strategies for farmers initiated by the government, is crucially important in pandemic and post-pandemic times. As the projected

situation of small farmers is explained by the reduction of production in post-COVID-19 times, their ability to invest into farm production is hampered. In this case, giving microcredits to households who suffer from the augmentation of shocks plays a particular role in the mitigation of the adverse effects on production and income (Harris et al. 2020).

In addition to this, a cash transfer to farmers is another means of market-let support which could counteract the decrease in purchasing power of farmers in the food chain (Sperling 2020). As a practical example, Myanmar's policy of providing cash transfers, improving the availability of agricultural inputs and increasing the flexibility of agricultural loans, can be applied to other country contexts (Boughton et al. 2020). In addition, policy actions implemented by insurance services for farm entities in China, price support through procurement in Egypt, Sri Lanka, and Mali, soft loans to farmers in Kazakhstan or Kyrgyzstan, and different relief packages in Pakistan are other examples of strategies increasing the resilience of farmers during a pandemic (IFPRI 2020).

Although this requires changing the form of trading to some extent, with related security measures in place, keeping a stable food supply chain thus becomes more realistic. One of the most judicious approaches in dealing with the current pandemic is to maintain a resilient food system, which translates into possibilities of preparedness for a shock or possibilities to make the shock less severe (Kahiluoto 2020). Looking at the Central Asian context, except from Turkmenistan, a total of 218 COVID-19 response policies have been implemented, in which increasing food resilience is actively included to deal with increasingly difficult situations in food security (IFPRI 2020).

Another important issue for maintaining production levels is paying attention to the importance of horizontal and vertical relationship between farmers and other participants in the food system (Martins, Trienekens, and Omta 2019). In this regard, maintaining farmer roles in the food supply chain is one of the most frequently mentioned policies against chain disruptions. In addition to investing into food security overall (Heigermoser and Glauben 2020), a strong commitment to support farmers makes the food system more resilient (Rashid, Theobald, and Ozano 2020; Petetin 2020). In this context, one alternative way to support the supply chain is boosting the participation of farmers in channels similar to indoor farmer markets (Preiss 2020; Wegerif 2020). The state should support the operation of the food supply chain with critical infrastructure, by ensuring farmers' participation. Taking into account that farm productivity in the food market may stall due to the pandemic, the enhancement of e-commerce for farmers in the food chain is another form of support (FAO 2020b; Amjath-Babu et al. 2020). In pursuance of farm support, an increasingly common form of help is the creation of farm-to-market linkages during and after the pandemic (Kumar, Padhee, and Kumar 2020). The launch of Kisan Rath mobile apps in India during the pandemic or that of a digital platform for tea auctions in Sri Lanka are both examples of direct farm policies implemented against COVID-19 disruptions. All these logistic innovations, as part of the promotion of rurally focused e-commerce (Waibel et al. 2020) in the food system, avert a chain collapse by strengthening food system resilience (Zimmerer and de Haan 2020).

At the same time, the mobilization of resource movements also becomes difficult. As farm production has been influenced by bottlenecks in inputs, the distributions in both input and output movements should be relaxed to such an extent that disabled channels for food production are recovered. Maintaining the food value chain is achieved by minimizing logistics disruptions (FAO 2020b), thereby influencing the basic channels of food transmission (Schmidhuber, Pound, and Qiao 2020). In this case, the role of emergency systems is crucially important, because coordination at different levels of food production and distribution synergies between actors ensure the resilience of the food chain. As for the improvement of food channels, evidence from China has shown that the national emergency food supply system (NEFSS) led to effective responses in warehousing, transporting, and distributing by emergency centers or enterprises (Pu and Zhong 2020).

3.3.2. Social protection

The subject of social protection, together with food security and nutritional program nodes, is highlighted by 42 sources in the dataset, accentuating its importance in dealing with the consequences of the pandemic (Figure 8). Generally, there are three frequent social protection measures used merely as mitigation strategies, namely social assistance scheme; social

insurance measures; and labor market measures (FAO 2020d; Gentilini, Almenfi, Orton, et al. 2020). As of 10th July, 2020, USD 589 billion in the world had already been spent on such social protection measures, with 75 countries spending on social assistance, 21 counties spending on social insurance, and 17 countries spending on labor market measures (Gentilini, Almenfi, Dale, Lopez, and Zafar 2020).

Social assistance transfers have become one of the most used strategies during the COVID-19 pandemic, accounting for 60% of the global response in social protection measures (Gentilini, Almenfi, and Dale 2020). A cash transfer-based social protection response is the most used type of social assistance scheme implemented in more than 130 countries (Gentilini, Almenfi, Dale, Lopez, Canas, et al. 2020). Social protection policies linked with pro-poor cash transfers are important to prevent the worst effects of a pandemic (Okoi and Bwawa 2020). Cash transfer programs targeted at the most vulnerable ultimately help them cope with extra difficulties experienced in their livelihoods. For example, the Government of Malawi's Social Cash Transfer Programme (SCTP) provides about MK 7,000 monthly (UNICEF 2020a), the Kartu Sembako Programme in Indonesia gives monthly cash assistance of about Rp 200,000, and the Targetted Social Assitance (TSA) in Georgia supplies the amount of TSA 21,000 for 6 months (UNICEF 2020b), in programs targeted at vulnerable families affected by the COVID-19 pandemic. Within the context of social assistance, there are special targeted programs aimed at finding alternative provisions for vulnerable children who are missing daily school meals. However, the situation has already shown that the state is required to pledge relief packages for providing nutritious food for children (Alvi and Gupta 2020). On the whole, 71 countries have already implemented alternative provisions for school meals, 49 countries are offering take-home rations, and 11 countries are issuing social security cash transfers to families with school children (WFP 2020a). Implementing adequate social protection measures through cash transfer programs or special targeted food programs plays a significant role in the protection of vulnerable people (Rutayisire et al. 2020; Mishra and Rampal 2020), and healthy diets (Abbas and Kamel 2020) and nutritional programs (Panthi et al. 2020) are central points of such programs. COVID-19 response programs like Integrated Child Development Service in India or a special package identification that includes potatoes, pulses, oil, onions and salt in Bangladesh have become some of the most influential nutritional programs, providing minimum required rations to marginalized people (Jribi et al. 2020). Additionally, some countries have adjusted already existing programs instead of putting new target-based ones in place. An example is the adjustment of India's Targeted Public Distribution System (TPDS), which is the world's largest food program, serving more than 813 million beneficiaries each month (WFP 2020b). Moreover, there is a special COVID-19 response program designed for the social protection of women in Latin America and the Caribbean, transferring special bonds (FAO and ECLAC 2020), or eight special programs for supporting nutritional programs in Latin America and Asia (Roy et al. 2020). In this case, a gender-sensitive social protection program that encourages the productive capacity of women is one alternative way of designing policy intervention (FAO 2020c; Lawson-Lartego and Cohen 2020), putting women at less risk of later impairment in the post-pandemic period (Roy et al. 2020).

Looking at supply side measures, there are two main comprehensive schemes known as social insurance and labor market measures, providing incentives and support for health and income protection, respectively (Gentilini, Almenfi, and Dale 2020). These programs have a particular significance in these historically unprecedented times. The scenario currently unfolding has shown the significance of financial support to those who are unofficially unemployed, although it is still insufficient. As of July, 2020, 136,7 million people from informal sectors were entitled to cash transfers in response to COVID-19 (Gentilini, Almenfi, Dale, Lopez, and Zafar 2020). For example, the government of India has already implemented a massive relief effort to allocate Rs 500 per month to the bank accounts of 200 million unemployed women (Swinnen and McDermott 2020); however, such stimulus packages still only have a limited capacity to deal with the ravages of the outbreak (Sharma, Talan, and Jain 2020). Another similar situation can be observed in Kazakhstan, where the government has implemented a special package of unemployment benefits of KZT 42,500 (IFPRI 2020). Ensuring income security can be realized with the help of sickness benefits and unemployment protection. For example, infected people in Vietnam are entitled to receive

VND 60,000 as a daily food allowance, the government of the Philippines has made PHP 1.billion available in unemployment benefits, and the government of Indonesia has mobilized IDR 500,000 for 2 million people as one of its supply side measures (ILO 2020). Generally, the effectiveness of immediate response measures through labor market or social insurance measures in the Greater Mekon Subregion (GMS) countries has already strengthened the resilience of rural households (Waibel et al. 2020).

4. Conclusion

This study explored the impact of COVID-19 on households in developing countries. A revision of 150 publications from the international literature reveals effects of food insecurity and market imbalance in connection with socio-economic consequences. As developing countries are witnessing aggravations on an unprecedented scale, this study found main mitigation strategies linked to farm support, food resilience, and social protection. Generally, we can say that the outcome of COVID-19 is a vicious circle whereby distributions of food supply chains, economic access to food, and nutritional balance are characteristics of global socio-economic changes, which is in line with the literature on impacts of the pandemic (Savary et al. 2020). In the case of mitigation strategies, the majority of them are aimed at increasing the resilience of rural households, farmers, and the food system.

The majority of publications agrees on veering away from traditional schemes to protect small farmers towards more inclusive safety net programs enhancing farm productivity. Studies recommend target-based policy actions protecting farm activities by providing supporting packages, which offer credit opportunities to challenge the distortion on the production caused by COVID-19. As microcredits play a particular role in the mitigation of adverse effects on income and consumption, short-term stimulus packages which sustain the proper functioning of food chains should be considered, promoting access to rural finance. Particularly the enhancement of access to agricultural services and inputs, in order to encourage productivity during and after the shock and thus to protect farmers, seems to be an important policy in this regard. As smallholder producers play a particularly significant role in developing countries, creating access to agricultural services reduces value chain disruptions.

Keeping the food supply chain active is an important task of many governments, and therefore sustaining food logistics by encouraging small farmers' roles in food production is an important measure to encourage efficient operations. Moreover, lessons learned from the COVID-19 pandemic so far underline the importance of e-commerce. The use of digital technologies has seen a dramatic increase in almost all sectors because of COVID-19, promising another era of digitalization. Because they promote an appropriate enhancement of food supply chains, innovation technologies which strengthen e-commerce regulations create another safe corridor within food chains.

Farm-system-for-nutrition approach (FSN) is another important approach to maintaining food security. Related to that, home gardening and urban agriculture encourage further strengthening of the food supply. In order to sustain the resilience of a food system during a pandemic, food and nutrition security is attributed to home gardening or urban agriculture, which also leads to a balanced diet within households.

Prioritizing national socio-economic protection policies by offering food assistance programs might help balance long-term food-supply consequences of the ongoing pandemic. In this case, implementing agencies in developing countries which can deal with flexibilities in procurement and delivery of food products may become an indemnity against the loss experienced by vulnerable people in developing countries. The reviewed studies agree that countries highly dependent on unorganized and unofficial daily wages should explicitly consider stimulus packages providing for the unofficially unemployed rural population. As COVID-19 has influenced labor migration in a staggering manner, the measures to call a halt to an increasing vulnerability among migrants are likely to reduce the risk of negative consequences.

Government social protection systems function as a means of protecting the most vulnerable, thus controlling the increasing rate of inequality during or after the COVID-19 pandemic. Any appropriate buffering policy should certainly consider supporting rural women with special social insurance measures, an approach which is linked to reducing

gender inequality in food security. Furthermore, special nutritional and diet programs counteract malnutrition consequences of COVID-19.

This review study identified several fields for further research. In particular, a policy formulation for food systems linked with health outcomes is stymied by the absence of a strong research agenda. Therefore, more attention should be given to food system research, in order to maintain a status quo in regards to COVID-19 consequences on the food system and health outcomes. Discussions should certainly consider related factors which characterize resilience during and after the pandemic. In order to explore new challenges and opportunities around the subject of food systems, future research should consider these other directions. As a first step, a critical mass to instigate a new approach towards the food system needs to be established. It is of especially urgent importance to study the resilience of farmers and food systems under the shock. Secondly, future research should put an emphasis on the adaptability of food supply chains by synthesizing low-and middle-income country strategies during and after the pandemic. In their conceptualization, food system studies should consider associated risks to food supply chains. While different countries have already implemented diverse efforts to handle major bottlenecks in the food supply chain, it is crucially important to extend the knowledge bases in this area in order to formulate policy options. Moreover, it is important to contribute to the development of a strong research agenda on COVID-19, while specifically considering gender studies in the food system. In the case at hand, gender equality, the gender gap, women's empowerment, and gender violence can be considered motives for furthering the recognition of "gendered" food systems in policy responses. Lastly, there is also a need for research on the accuracy of early warning systems to interpret food security signals, thus cementing the linkage between better food security projection and credible mitigation strategies. Inaccuracies may be associated with technical issues as well as political motivation. Therefore, research focusing on short- and long-term food security predictions should be prioritized.

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DIGITAL ECONOMY WITHIN THE EURASIAN ECONOMIC UNION: CURRENT STATE AND DEVELOPMENT PROSPECTS

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Abstract

Theoretical ideas about the influence of growing information flows on the current socio-economic system can be found in the concepts of the post-industrial and information society. Changes in production processes, the reorientation of production with the development of material goods for the provision of services, the globalisation of the economy are noted by theorists of the digital community as more fundamental properties of the newest type of society, caused by informatisation. The digital era is defined by continuous streams of data containing information, knowledge, ideas, and innovation. Global digital transformation (digitalisation) has changed not only the economic, but also the social vision of the world. The rapid growth of high-tech production is a key development trend in the modern world industry. However, the situation in developing countries as well as in "countries with economies in transition" differs from that in developed countries. Accordingly, the purpose of the study is to analyse digital transformation in the socio-economic aspect of the countries of the Eurasian Economic Union. The readiness of the countries of the Eurasian Economic Union (EAEU) as a whole for the digital transformation of the economy and society. Within the framework of the study, the main theoretical approaches to understanding digitalisation and its main processes are identified, the opinion of various authors regarding the understanding of the category of digitalisation and digital transformation of the economy is presented. The trends of digital transformation of both the Eurasian Economic Union and in the context of the participating countries, the main prerequisites and main difficulties in this process are considered, the main problems are identified, and the main prospects are also considered. Prospects for further research are conditioned by the subsequent study of the trends in digital transformation of the EAEU countries, considering the differentiation of the EAEU countries by the level of industrial development, as well as by the degree of lagging behind the global transition trends. The study is of practical value within the framework of summarising data on the main directions of digital transformation development, as well as on the existing difficulties in the EAEU countries regarding this process.

Keywords: Industry 4.0, digitalisation, business structures, digital transformation, national economic systems.

JEL classification: F55, F63, R50

1. <u>Introduction</u>

The current stage of development not only of the economy of the whole world, but also of national economic systems, is described by significant transformation processes, which are accompanied by a complex of changes in various directions, with their full interconnection. There are many approaches that can explain and capture these transformational processes. These include: N. Kondratyev's approach (the theory of long waves) to the concept of F Machlup (the knowledge economy); J. Galbraith's approach (new industrial society) with the transition to D. Bell's approach (post-industrial society). The last transition is mediated by changes in the factors of competitiveness of enterprises, as well as structural shifts in the economies (in this situation, this refers to the global scale and national economies). Furthermore, in the last transition, there is a change in the ratio of the importance of factors of production and an increase in knowledge of the capacity of goods and services. Within the framework of the study, it is possible to designate both network and innovative approaches, which reflect the development of technologies in the field of working with information, its processing and transfer (Belyakova et al., 2017). Considering the situation at large, one can refer to transformation processes in relation to the conditions of economic activity. This is conditioned by the competition of a global nature, which is reflected in the reaction of economic entities to changes in the external environment, both technological and structural, and the possibility of rapid adaptation to these changes. In terms of reaching a new level of competitiveness and economic efficiency, in this situation it is received by those who adjust their development in relation to the key trends in the development of a new global economy (Rodionova and Kokuytseva, 2020).

In this situation, international competition for the prosperity of the people is critical. Since the competitiveness of the economy allows economic entities to trade in products, both in the country and abroad. This, in turn, leads to an increase in the income of the population, as well as its employment (Petersen, 2019; Koudoumakis et al., 2019). The current stage of development is described by the fact that the competitiveness of the economies of countries and economic unions is becoming most dependent on the scale of the use of digital technologies in production. In this context, this refers to digital transformation, which is directly dependent on the availability of the resources in the country, which are necessary for this transformation. In this regard, the relevance and practical significance of the study of digital transformation trends in the socio-economic context increases both for a separate territory and for integration systems (economic unions). The purpose of the study was to analyse trends in digital transformation in the socio-economic context of the countries of the Eurasian Economic Union (EAEU) with the identification of positive and negative aspects. There are many studies investigating the processes of digital transformation of economic systems, here one can note the articles of foreign researchers: V. Alcácer and V. Cruz-Machado (2019), S. Carbó-Valverde (2017), C. Heavin and D. J. Power (2018), and others.

The article of the authors such as Yu.I. Gribanov and A.A. Shatrov (2019) can be noted, which explores the essence, content, and role of digital transformation in the development of economic systems. It is worth noting the article of Doctor of Economics, Professor A.V. Babkin (2017), which investigates the trends in the digital transformation of the economy and industry, their problems and prospects. O. Gurov's article covers the study of digital transformation processes in relation to economic unions (Gurov, 2019).

All of the above indicates the need for further study in order to investigate the trends of digital transformation in the socio-economic context of the countries of the Eurasian Economic Union. The theoretical significance of the study lies in expanding and supplementing theoretical knowledge regarding the processes of digital transformation at the level of countries' economies. The practical significance lies in the fact that the problem of digital transformation at the country level, as well as integration associations, is one of the rather urgent at the present stage, its elaboration can help identify the main reasons that hinder the development of this process both at the level of one territory (country) and within the framework of economic integration.

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2. Literature Review

At the present stage, the development of a new philosophy of management is required, and in all directions and in all systems, regardless of scale, this is primarily conditioned by a high degree of uncertainty caused by the high speed of ongoing changes, also the emergence of completely new growth formats, the rapid pace of technological change, the emergence of new megatrends, new drivers of economic development (Nekhorosheva, 2016; Nekhorosheva, 2017). Table 1 presents some of the results of the main megatrends identified by researchers and research organisations.

Table 1. Major megatrends of global significance

Name	Megatrends
John Naisbitt (USA)	Transition to an information society
	Achieving a kind of dualism, which lies in the balance of technical progress and a spiritual approach
	Switching to the long term from considerations of the moment
	Transition to decentralisation
	The main self-reliance is a deviation from faith in the help of institutions and organisations
	Transition to the use of informal networks from hierarchical structures
PricewaterhouseCoopers – Global Consulting & Auditing Network, Strategy & Leadership Group (USA)	Technological breakthrough
	The global economy and the reallocation of power
	Demographic changes
	Acceleration of urbanisation processes
	Resource scarcity
	Climate change
European Commission	Globalisation
	New markets and their development
	Climate change
	Formation of the knowledge economy
	Resource shortage, depletion

Notably, the main directions of development of megatrends are similar, which are distinguished by the sources presented in the table. Arguably, a number of highlighted megatrends create conditions for the development of Industry 4.0, these include: the development of a knowledge economy, the redistribution of forces in the global economy, the transition from an industrial society to an information society (Carbonara and Giannoccaro, 2016; Margarian, 2013). At present, Industry 4.0 can be called one of the most important modern megatrends, which is gaining rapid development rates. The current trends have a significant impact not only on the economy, but also on society as a whole and on the individual, as well as on the ongoing social processes. The impact of such a global megatrend as Industry 4.0 carries with it the processes of digital transformation, which is taking place in all areas, both in the economies of countries and in society. It is necessary to understand the concepts of what digital transformation is, it is necessary to introduce some certainty in the terminology.

In the broadest meaning, digitalisation is usually understood as a socio-economic transformation initiated by the numerous introduction and development of digital technologies, that is, technologies for the design, processing, exchange, and transmission of data. The digital economy is an economy described by the active implementation and actual use of digital technologies for collecting, storing, processing, transforming, and transmitting data in absolutely all spheres of human activity. It is a concept of socio-economic and organisational-technical relations based on the use of digital information and telecommunication technologies. Furthermore, it is a complex organisational and technical concept in the form of a set of various elements (production, infrastructure, organisational, software, regulatory, legislative, etc.) with distributed interaction and mutual use of economic representatives in order to exchange knowledge in conditions of constant development. The

key to defining a digital concept is the exchange of knowledge, the technologies that enable it, and the society that can take part in this exchange and manage it.

At the present stage of development, society is entering the era of the digital economy, which significantly changes the usual zones:

– the main resource is information;

– the absence of restrictions regarding the trading platform on the Internet;

– the company does not need to have significant scale to compete successfully;

– one and the same material resource can be used an unlimited number of times to render different services;

– the scale of operational work is limited only by the scale of the Internet.

The Internet, with its colossal potential, is considered the main component of the digital economy, increasing efficiency and productivity.

In modern scientific literature, digitalisation is defined as an integral component of the modern global economy, which contributes to more rational resource management (Antikainen et al., 2018), optimisation of business management models (Rachinger et al., 2018) and structural change (Heavin and Power, 2018). It also complicates workflows, speeds up innovation cycles (Lato, 2018; Larionova et al., 2018), and improves supply chain management (Srai and Lorentz, 2019). Digitalization is leading to the internationalisation of industries and startups (Neubert, 2018) and the creation of manufacturing ecosystems (Alcácer and Cruz-Machado, 2019).

Digitalisation is responsible for making modern production individual. This means that product development is tailored for each client (Paritala et al., 2017). Manufacturing includes visualisation, production simulation, ergonomic and human factors analysis, a comprehensive approach to product and process design, and product design that is sensitive to process constraints and capabilities. Modern production (for example, chemical processing) is impossible without data analysis, network systems, artificial intelligence, the Internet of Things (IoT), digitalisation of business processes, as well as all the characteristics of Industry 4.0 (Kockmann et al., 2018).

The process of global digitalisation, its penetration into all spheres, is a digital transformation. This refers to the informatisation of business processes, both horizontal and vertical, this state of affairs indicates the development of a competitive environment at a newer level, where the time factor will play one of the most important roles (Babkin, 2017).

Technological development and ongoing changes in technologies have led to the evolution of the content of the term "digital transformation". At the initial stage, digital transformation was understood as storing traditional forms of data in digital format or transferring data to digital format. At the present stage, this has become one of the areas of digital transformation. The concept itself has become much broader, due to the business structures understanding the possibilities of the use of such data in relation to business processes, which led to the emergence of digital technologies, which were actively developed and quickly introduced and directly determined the competitiveness of such business structures. Part of entrepreneurs and managers in general believe that a digital transformation process is necessary, which allows enterprises to "keep pace" with changing consumer expectations and technologies. Expanding the scope of understanding digital transformation leads to a plurality of understandings of this definition. However, some researchers and practitioners against the specification of this concept can also include IT specialists, which is due to the constant development of digital technologies, respectively, this term is also subject to constant changes and expansion, that is, it also evolves in relation to the development of technologies (Gribanov and Shatrov, 2019). However, certain main aspects can be identified from the multitude of interpretations of this definition.

Notably, there are many terms within the concept of digital transformation:

– digitisation, which was discussed within the framework of the evolution of the concept of digital transformation (initial stage). That is, this refers to the transfer of information to digital media from physical media (Koptelov, 2016). This process does not imply any change in information (neither its content, nor its quality), it just changes the form, which allows to add another information to this information, also in digital format, and improve existing business processes. If this process is considered in relation to the industrial revolution, then it can be attributed to the third industrial revolution, which lasted until 2010;

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– digitalisation – this refers to creating a new digital product. The main difference here is an innovative product that has new consumer properties and new functionality. Furthermore, digitalisation allows to get new competitive advantages and a new leap in business, in contrast to digitisation, which only allowed to improve existing processes and existing business models. As for digitalisation, it can be considered as an element of Industry 4.0 or the fourth industrial revolution.

The global process of digitalisation of production (the spread and penetration of digital technologies in the entire sphere of the vital activity of society) suggests the emergence of such a concept as a digital economy, which the World Bank experts represent as a system of relations, both socio-cultural and economic based on the use of information and communication and digital technologies.

Notably, some companies, both within the framework of large and medium and small businesses, perceive digitalisation as automation, namely, its new round. However, this is not entirely correct, since automation implies the liberation of a person, or a decrease in their participation in the work process (receipt, transformation, transfer and use of materials, energy, etc.) (Gribanov and Shatrov, 2019). What is digitalisation was discussed above and suggests the difference of concepts. In the report "Russia 2025: From Human Resources to Talents", the Boston Consulting Group understands digitalisation as the use of digital technologies and online opportunities from large companies and states to individuals, that is, by all participants in the economic system (Russia 2025: From Human Resources..., 2017). As for the understanding of digital transformation, to a greater extent it is the possibility of making more money in relation to the conditions of constant changes taking place in the technological order, the possibility of maintaining a competitive business. As for business structures, the desire for sustainable functioning in the new economic conditions forces to take part in digital transformation and go through it. The term "digitalisation" is used to describe the transformation, which is not limited to the replacement of a resource from analogue to digital or from physical to information, but goes much further, which is why the term "digital transformation" is synonymous with the term "digitalisation". Digital transformation is a change in thinking about a new digital economy and new conditions, not just technological change. Like any process, digital transformation has its positive and negative effects. The former finds its manifestation from an individual consumer to the country at large, that is, at all levels of the economic system. At the very least, digital transformation carries with it the possibility of using digital technologies (full potential). If viewed from the maximum: development of innovative business models (Napolskikh and Yalyalieva, 2019; Larionova et al., 2018); numerous opportunities for growth, cost reduction; increase in the efficiency of doing business; improvement of the shopping experience – namely, rethinking the very format of the economic system, its functioning.

The main positive directions of digital transformation in the socio-economic context can be identified as follows:

– service infrastructure (the ability to personalise and create attractiveness) striving to meet specific needs, which, in turn, is expected by modern customers;

– receiving additional income (new streams) as new ways of generating income with the use of new technologies are opening up;

– processes at the enterprise become more optimised, which is conditioned by the exclusion of intermediate processes in relation to more complex processes and the automation of simpler processes through the use of new technologies. There is an opportunity for more efficient use of resources and, accordingly, increasing the flexibility of enterprises.

The widespread digitalisation of industries and other areas makes not only enterprises competitive, but also increases the country's competitiveness. Therewith, the country can increase its gross domestic product by increasing the production of goods and services. This refers to global redistribution since the growth of human well-being is also associated with a successful digital transformation. Ignoring the digital transformation processes by countries leads to a drop in GDP per capita, since the products, goods, and services of such a country become practically uncompetitive. Accordingly, digital transformation in the socio-economic context for the country becomes a necessary condition for ensuring its well-being, increasing this well-being. The digital transformation can be considered in a socio-economic context relative to the experience of different countries. In general, the digital technology

implementation model was developed for high-tech industries (for example, the pharmaceutical industry). However, digitalisation of a separate industry is impossible, since digitalisation is a complex process that combines government procurement of medicines, production control, supplies to pharmacies and hospitals, and medicine inventory (Chircu et al., 2017). Therefore, a digital transformation of the entire industry is required.

Considering the experience of developed countries, for example, Finland has proved that digitalisation of healthcare directly affects the commercialisation of high technologies in this area. A survey of pharmaceutical, medical, and electronic health companies in Finland indicated that digitalisation has positively influenced commercialisation, especially in information search and management, various assessments and official actions, creation of big data and performance standards. However, at the same time, it threatened national security due to the possibility of external health management, deliberate hacker attacks and data fraud (Gbadegeshin, 2019; Dynnikov, 2017). Digitalisation has penetrated the socio-cultural sphere. There are two scenarios for the music industry in the digital age (Bourreau et al., 2008): profit from the sale of content that requires direct or indirect protection of music files, or through the (almost) free distribution of content and the sale of additional goods or services. Digitalisation can be said to negatively affect the music, publishing and film industries due to piracy and disregard for copyright in books, music, radio, television, and film (Waldfogel, 2017). On the other hand, digital technologies have helped this area to reach new target groups. This has expanded the consumer base and reduced the cost of bringing new products to the music, film, book, and television markets. Furthermore, given the unpredictable nature of product quality in this industry, the growth in the number of new products has led to a significant improvement in the quality of these products.

Digitalisation has significantly transformed education. In developed countries, the typical classroom includes all forms of e-learning and teaching (Mashhadi & Kargozari, 2011). At present, skills and knowledge are transferred through computers and networks. This means that the forms of presentation of educational material and the development of skills have completely changed. The digitalisation of education leads to an increase in demand for education regardless of age. Teachers and students use a limited number of digital technologies mainly for learning tasks, and the educational management system is considered the most useful tool (Bond et al., 2018). Thus, it can be concluded that digitalisation affects all spheres of the country's economic and social life. However, in this context, the issue of integration associations of countries into economic unions becomes quite interesting.

Notably, the basis of the global trend of globalisation is also manifested in the growing interconnection, interdependence, and mutually beneficial economic cooperation of countries in the context of a global unstable process, which can be observed in the countries of Europe and Asia. This circumstance is a condition of priority in the development of management – in the benefit of the integration processes of national economic systems. In this context, integration processes are one of the crucial factors for economic growth and sustainable development, as well as increasing the competitiveness of countries. Currently, integration unions, which include several member countries, are quite effective in their activities. One of these unions is the Eurasian Economic Union (EAEU). Compared to other integration unions such as the EU (European Union), the European Free Trade Association (EFTA) and some others, the EAEU is quite young. This association of countries can be called one of the dynamically developing ones. In line with current trends in the global process of digital transformation of the economies of countries, the importance and significance for future development in terms of the digital transformation of the economies of the EAEU member states are reflected in the main directions of the EAEU Digital Agenda until 2025, in which digital transformation is positioned as the main factor of development. In this document, the EAEU states agreed on the ways and means of the region's development to increase its competitiveness in the international arena and improve the quality of life of its citizens through the development of a single digital space (Physentzides, 2012).

According to the Eurasian Economic Commission (EEC), digitalisation plays a key role not only in the legislative sphere and economic processes, but also in the humanitarian aspects of integration, opening up new opportunities for all-round and comprehensive cooperation based on a single network infrastructure that establishes a common digital space (Gurov, 2019). This space allows to combine various domestic and private digital platforms

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(information systems and digital solutions) for the prompt receipt of goods and services by users, concluding transactions, processing tax and customs documents, exchanging information with controlling government agencies and other participants in international trade and cooperation. Experts predict that the creation of common digital platforms and the introduction of new digital solutions will eliminate barriers to the movement of goods, services, capital, and data, create new jobs and develop previously non-existent areas of business activity and even entire sectors of the digital economy (to which all countries of the world are striving), which should ultimately lead to an overall economic growth of the EAEU member states and an increase in the welfare of their citizens (Latos et al., 2018).

Summarising the results of the analysis of literary sources, digital transformation can be represented as the introduction of modern digital technologies into the business processes of an enterprise, which allows not only to change the quality, but also to create a new one. This refers to fundamental changes in management, external communications, and corporate culture, and not just to the installation of modern equipment. This process enables the company to gain a reputation for being a modern and progressive organisation, increase customer satisfaction, and improve employee productivity. In this situation, a digital transformation can be traced both in the economic context and in the social one since most of social spheres have also undergone digitalisation.

3. **Materials and Methods**

To measure the development of digital transformation in a socio-economic context, the Organisation for Economic Cooperation and Development (OECD) has developed a system of indicators (Falk, 2006), which determines the following trends: the development of a high-tech sector of the economy; investments in research, software development, education costs and ancillary retraining; creation and production of information and communication equipment; the establishment of working areas in the field of science and high technologies; data of collaboration between corporations, institutions and research organisations; international cooperation in the field of science and innovation; the dynamics of the spread of the Internet in the international market.

In general terms, four criteria for analysing the digital economy can be distinguished: they have been studied to varying degrees by different researchers:

1. Criterion related to the sphere of employment;
2. Spatial criterion;
3. Technological criterion;
4. Economic criterion.

The criterion related to the sphere of employment is directly related to the composition of the population's employment and the pattern of observed changes. The transformation of socio-economic relations is conditioned by the fact that most of the people work in digital fields. A decrease in the share of those employed in the production sector and an increase in the service sector are seen as replacing physical labour with informational labour. Since the main resource in this case is data, a significant increase in the share of labour in their processing can be considered as a transition to digital transformation and digital economy.

Some concepts of digital transformation of the economy are based on a geographic principle (Grimes, 2003). The main attention is paid to information transmission networks that unite different zones, and, as a result, the ability to influence the development of the world economic space.

According to the specialists of the Centre of Competence of the federal project "Digital Technologies" of the State Corporation "Rosatom", the main factors characterising the development of digital transformation of countries include: human capital, R&D and innovation, digital infrastructure, digital sector, business environment, national policy and regulation, information safety.

In this context, it is possible to draw up a certain system of indicators that reflects the digital transformation in the socio-economic context of countries, based on the above:

– dynamics of the GDP per capita indicator of the EAEU member countries;
– dynamics of growth of the main macroeconomic indicators of the EAEU member countries;

– dynamics of the share of the population with access to the Internet in the EAEU member states;

– dynamics of the number of researchers per million inhabitants in the EAEU member countries;

– dynamics of R&D expenditures by EAEU member countries;

– some key indicators of the competitiveness of the economies of the EAEU member countries in the field of digitalisation;

– dynamics of the global innovation index by EAEU member countries;

– distribution of the member states of the union in the rating of the global innovation index;

– dynamics of the network readiness index of the EAEU member states according to the World Economic Forum;

– distribution of member states of the union in the ranking of the network readiness index.

The research period is associated with the availability of data in the analytical reports of the EAEU in recent years.

As part of the analysis of statistical indicators, dynamic analysis of data volumes is used.

The main material of the study was the data of statistical and analytical reports and studies of the Eurasian Economic Commission and other data.

4. Results

The purpose of the study was to obtain information on the general trend in the development of digital transformation in the socio-economic context of the EAEU countries. As noted earlier, one of the main macroeconomic indicators describing the development of a country, and its competitiveness is GDP per capita, and countries' ignorance of digital transformation processes leads to a drop in GDP per capita (Amri, 2018). Below, the study considers the dynamics of the EAEU member countries (Fig. 1). Due to the lack of official data for 2019, an analysis of the dynamics of indicators for 2018 is provided. In general, it is necessary to note the positive dynamics of all EAEU member countries, which indicates the growth of the economies of the countries and the growth of their competitiveness. Next, the study considers the dynamics of the main macroeconomic indicators of the EAEU countries (Figs. 2, 3), since the shift in production indicators to the service sector indicates an increase in the informatisation of society.

Figure 1. Dynamics of the GDP per capita indicator of the EAEU member states, billions of dollars

Source: Eurasian Economic Commission, 2019a

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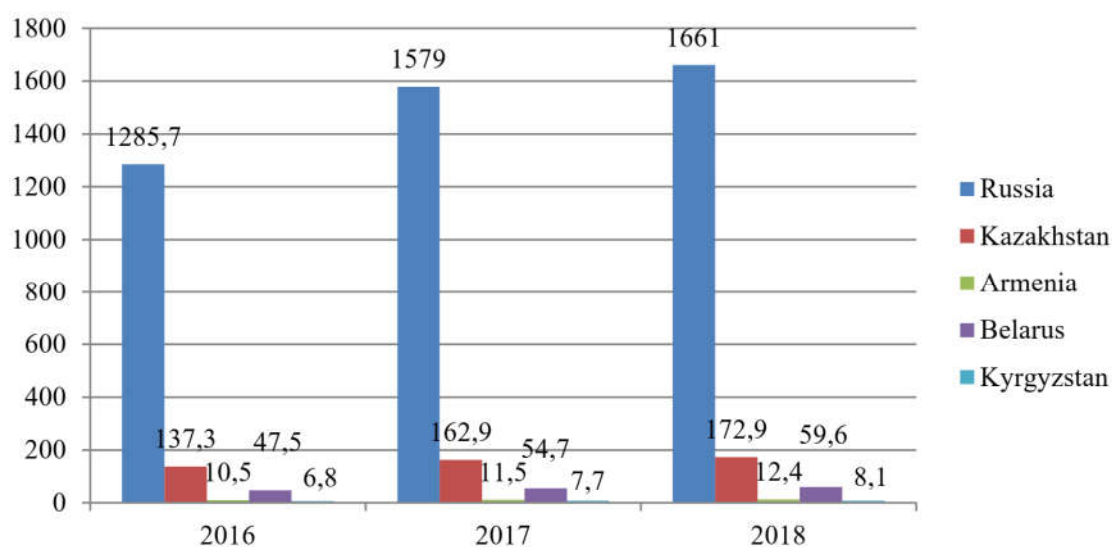
Figure 2. Dynamics of growth of the main macroeconomic indicators of the EAEU member countries in 2018, %
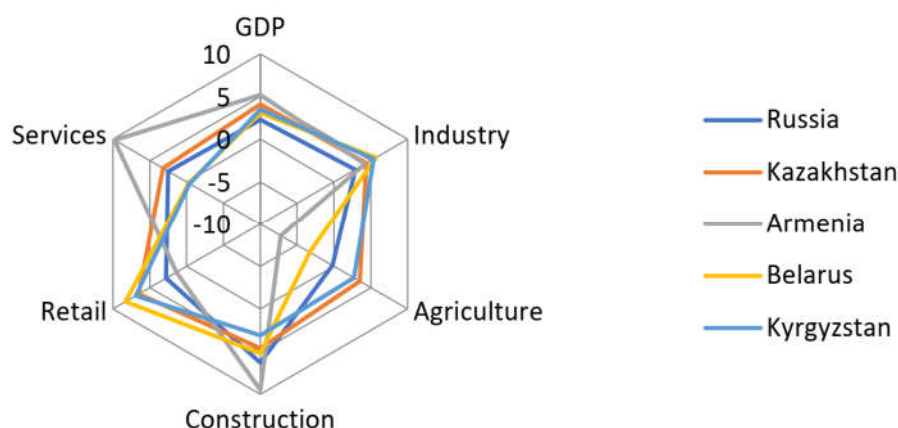
Figure 3. Dynamics of growth of the main macroeconomic indicators of the EAEU member countries in 2019, %
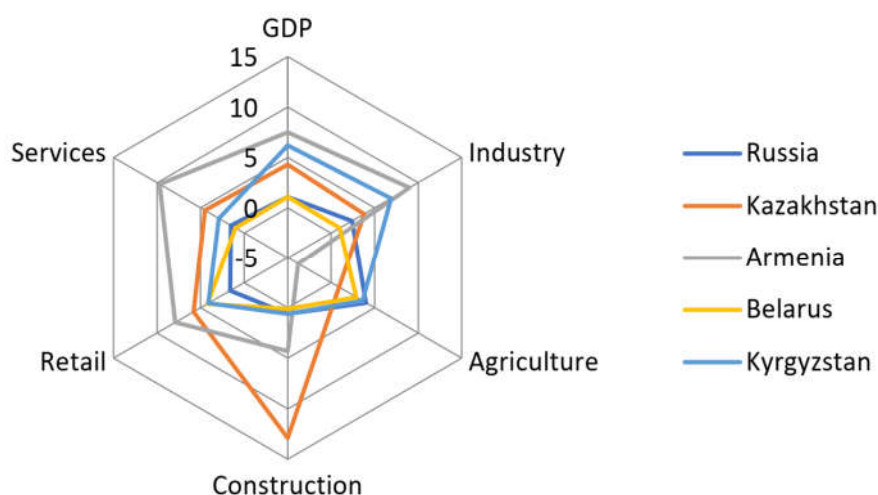
Source: Eurasian Economic Commission, 2020

In general, a relatively high increase in services remains in countries such as Kazakhstan, Armenia, and Russia. Therewith, it is necessary to note the growth in 2019 for such countries as Belarus and Kyrgyzstan. Considering the process of digital transformation of the countries that make up the EAEU, it is necessary to note the increase in the share of the population with access to the Internet (Table 2).

Table 2. Dynamics of the share of the population with Internet access in the EAEU member states, %

Countries	2015	2016	2017	Growth rate, %	
				2016	2017
Armenia	57	61	68	7.02	11.48
Belarus	63	79	84	25.40	6.33
Kyrgyzstan	30	32	38	6.67	18.75
Kazakhstan	69	73	75	5.80	2.74
Russia	70	72	75	2.86	4.17

Source: Centre for Integration Studies, 2019.

There are no official data on the EAEU countries for 2018, 2019. In general, it is necessary to note an increase in the share of coverage of the population with Internet networks. The

main problem in this direction is associated with hard-to-reach territories, such as villages and
settlements. The negative point is that, based on the data provided by the Eurasian Economic
Commission for 2016 and 2017, reflected in the work of S. Yu. Glazyev (Member of the
Board for Integration and Economics) – "On the Strategy of Eurasian Economic Integration in
the Context of Changing Technological and World Economic Structures" – the number of
employees engaged in research and development is decreasing. In 2017, the number was
765.6 thousand people throughout the EAEU, which is 1.9% less than in 2016. This trend is
quite negative in relation to the taken course of digital transformation, with the main number
of employees in countries such as Russia, Belarus, Armenia (Fig. 4).

**Figure 4. Dynamics of the number of researchers per million inhabitants by EAEU member
countries, 2018**
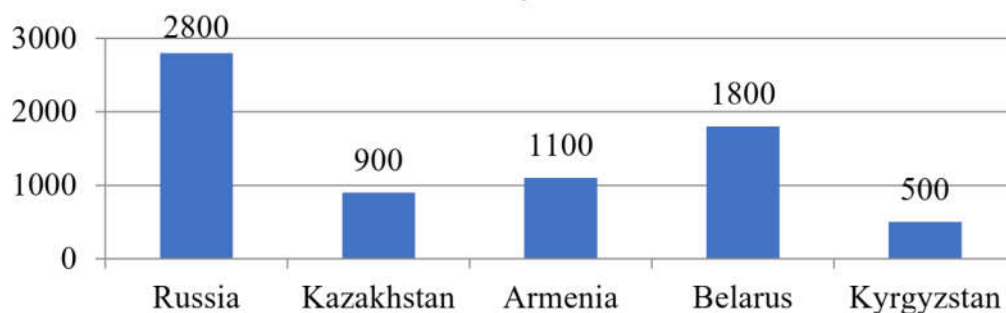
Source: Eurasian Economic Commission, 2019b.

It is also necessary to note the expenditures of states on R&D (as one of the factors
characterising the process of digital transformation of the country) (Fig. 5).

Figure 5. Dynamics of R&D expenditures by EAEU member countries, 2018, % of GDP
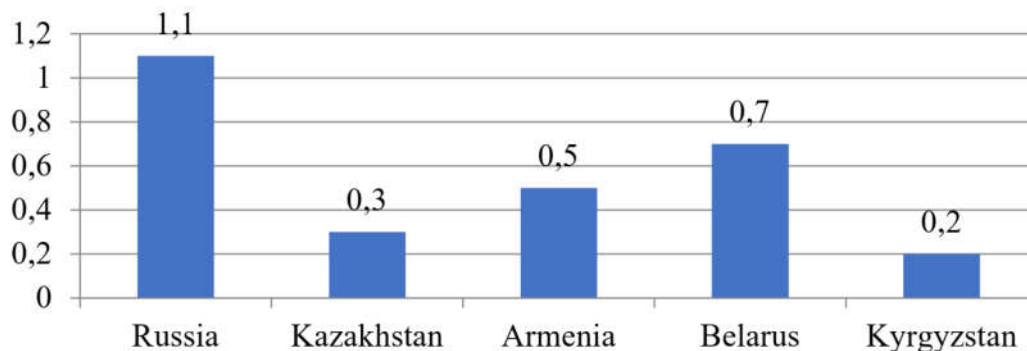
Source: Eurasian Economic Commission, 2019b.

Notably, the costs of the countries are quite small. Considering the EAEU in aggregate, the
share of expenditures is about 1% of GDP, while the EU expenditures are 2.0% of GDP, and
OECD expenditures – 2.4%. The process of digital transformation in the socio-economic
context of the EAEU member states can be described by some key indicators of the
competitiveness of these countries (Table 3). Considering the indicators presented in Table 3,
it is possible to designate a fairly high level relative to the indicator of electronic government
for countries such as Russia and Kazakhstan, which show almost maximum development in
this area.

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Table 3. Some key indicators of the competitiveness of the economies of the EAEU member countries in the field of digitalisation in 2018

Indicators	Russia	Kazakhstan	Armenia	Kyrgyzstan
E-government index (0 – 1, 1 – maximum development level)	0.92	0.84	0.57	0.69
Government orientation towards the future (1 – 7, 7 – max.)	3.87	4.13	3.84	3.16
Flexibility of the country's legal framework for digital business models (1 – 7, 7 – max.)	3.89	4.03	4.01	3.03
Mobile cellular subscribers (per 100 people)	157.89	145.42	119.04	121.92
Mobile broadband Internet subscription (per 100 people)	80.78	75.06	66.8	73.68
Fixed broadband Internet subscription (per 100 people)	21.44	14.14	10.76	4.27
Internet subscription "fibre to home/building" (per 100 people)	13.5	6.65	4.7	2.02
Internet users (% of the population)	73.09	74.59	64.35	34.5
Knowledge of digital technologies and computer literacy among the capable population (1 – 7, 7 – max.)	4.82	4.65	4.42	3.89
Growth rate of innovative companies (1 – 7, 7 – max.)	3.75	3.58	3.89	2.91

Source: Centre for Integration Studies, 2019.

The level of government orientation towards the future is average, which is due to economic instability. Notably, the legal framework is underdeveloped in terms of the digital transformation process. Rates of Internet use are rather high, however, Internet users among the population are not so high, especially in countries such as Armenia and Kyrgyzstan, which is also associated with the problem of territorial accessibility and the need to educate the population and adapt it to use new technologies. This indicator is also confirmed by the dynamics of the following indicator, which describes knowledge of digital technologies and computer literacy among the capable population (the indicator is the average value of the maximum). The dynamics regarding the growth rate of innovative companies is negative, being below the required level, which is due to the low expenditures of states on R&D. The dynamics of the digital transformation process in the socio-economic context of the EAEU member countries can also be traced in relation to the ratings. The dynamics of the global innovation index is shown in Figure 6. In 2018, Belarus, Kyrgyzstan, and Kazakhstan improved their positions. Considering it in aggregate for the EAEU, the union ranks 50th among 126 economies of countries, but there are different dynamics across countries, with the highest position in Russia. The EAEU holds the highest positions in the sub-indices "human capital and research" (28th place), "business development" (38th place), "results in the field of knowledge and technology" (51st place) and "market development" (57th place).

Figure 6. Dynamics of the global innovation index by EAEU member countries, place
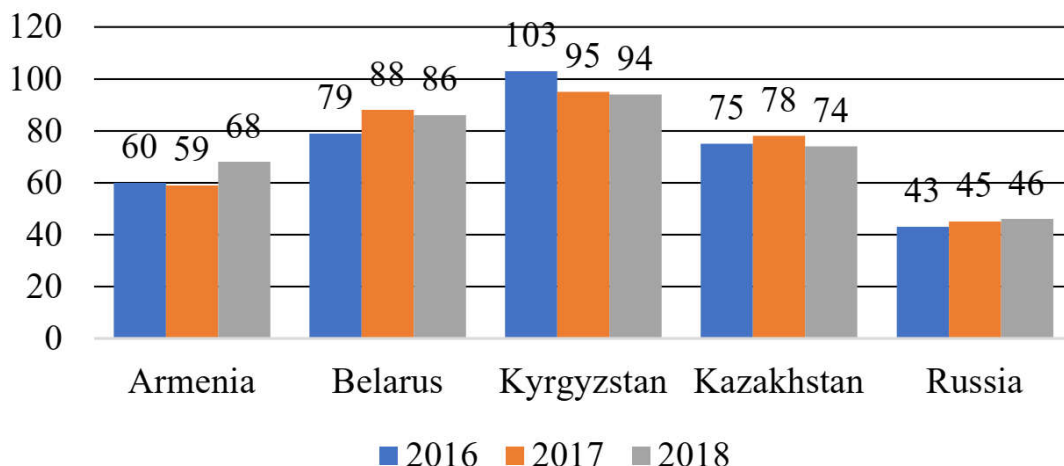
Source: Eurasian Economic Commission, 2018

Considering the rating of the global innovation index itself, the member states of the union are distributed as follows (Fig. 7).

Figure 7. Distribution of member states of the union in the ranking of the global innovation index, place
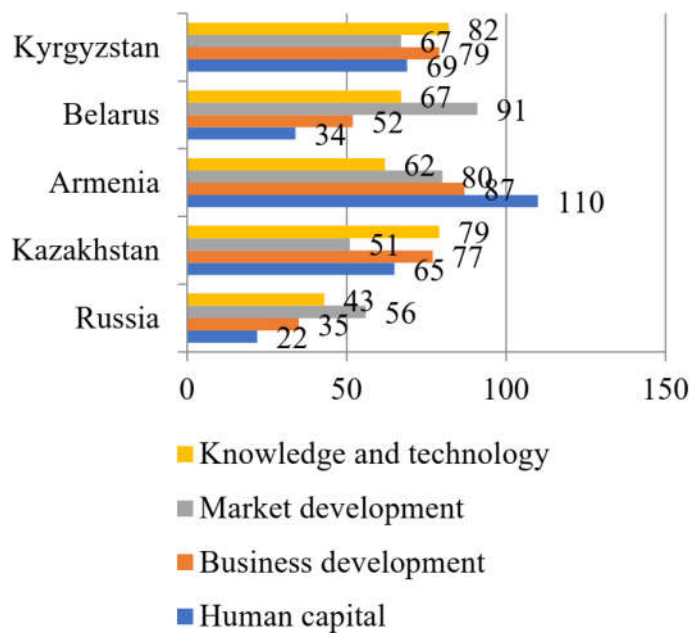
Source: Eurasian Economic Commission, 2018

In Armenia, there is a decrease in almost all sub-indices of the rating. On the contrary, Belarus has managed to increase its advantages in terms of business development. Kazakhstan also managed to increase its position relative to the previous period in such indicators as business development, as well as results in the field of knowledge and technology, but reduced its results in terms of human capital. The network readiness index of the EAEU member countries can also be considered (Fig. 8).

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Figure 8. Dynamics of the network readiness index of the EAEU member states according to the World Economic Forum, place
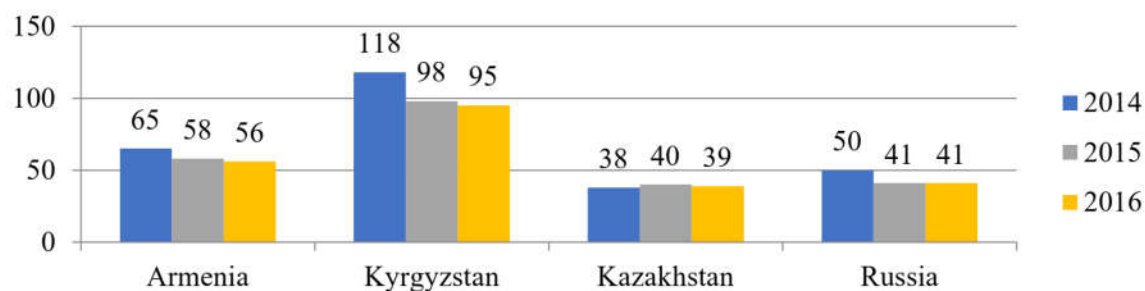
Source: Eurasian Economic Commission, 2018

The Republic of Belarus is absent from all ratings of the World Economic Forum. The dynamics of the index is indicated only for 2016, which makes the study on this indicator conditional. Nevertheless, the trends are evident, each of the countries displays positive dynamics, and considering it within the framework of the sub-indices included in this indicator, the situation will be as follows (Fig. 9).

Figure 9. Distribution of member states of the union in the ranking of the network readiness index, place
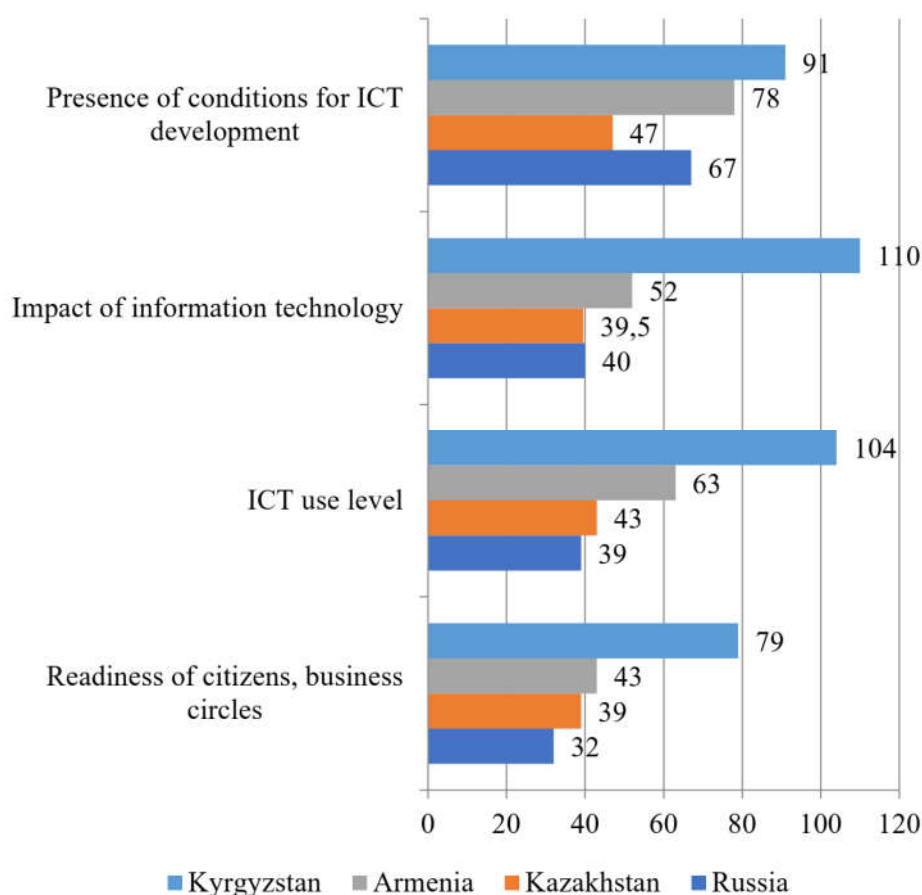
Source: Eurasian Economic Commission, 2018

Considering the EAEU integration association in aggregate, it ranks 41st among 139 economies of countries. Compared to 2015, the EAEU retained its previous position, including by maintaining the position of the Russian Federation at the same level (41st place) and minor changes in the positions of the other EAEU member states. Positive trends can be observed in all states. Armenia has improved its position regarding the readiness of citizens

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and business circles, as well as the level of ICT use. As for Kazakhstan, the level of availability of conditions for ICT development, as well as the level of ICT use and the impact of information technologies, have changed positively (Islam et al., 2012; Sklias, 2012). The complete set of positions has been improved in the Republic of Kyrgyzstan. The regulatory and legal framework for the implementation of digital transformation measures within the Eurasian Economic Union was the adoption of a set of regulations:

a) digital transformation of sectors of the EAEU economy, in particular in industry;

b) the general "digital" agenda of the EAEU, aimed at creating a common digital space of the EAEU.

Apart from joint activities within the EAEU aimed at introducing a digital agenda and its synchronization within an international organisation, the EAEU member states are also implementing their digitalisation programmes. Thus, the Russian government has developed a national programme "Digital Economy of the Russian Federation". Furthermore, regional programmes are being actively implemented, considering the specific features and promising areas of local development (Yalyalieva and Napolskikh, 2017). In Kazakhstan, the state programme "Digital Kazakhstan" is being implemented, the purpose of which is to actively develop the digital ecosystem to achieve sustainable growth and increase the competitiveness of the economy, as well as improve the quality of life of the population (Almeida et al., 2017). Summarising the results of the analysis, it can be noted that the digital economy in the EAEU member states is small, lags behind in development from the post-industrial countries, but has good potential for development. In all EAEU countries, there is an extremely positive dynamics in the development of basic infrastructure regarding the process of digital transformation of the economy and society. Growth in the proportion of the population with Internet access is observed. However, according to this indicator, in the EAEU countries, even within the region, there is a digital divide between states. Moreover, due to the heterogeneous infrastructural and economic development of the countries themselves, the gap is also present between different regions within countries, and first of all, there is a significant difference in the level of the ongoing digital transformation of the urban and rural environment. As for business, there is a positive trend in all EAEU countries. The development of a favourable environment on the part of the state is extremely important for the wider diffusion of digital technologies. Therewith, this refers not only to financing the development of digital infrastructure, but also to providing the necessary legal framework for digitalisation of business and the flexibility of government agencies to adopt new technologies. In the EAEU member countries, state measures and priorities for the development of the digital economy are set out in national strategies and several project documents in core areas. As for the participation of the governments of these countries in digitalisation, it is in Kazakhstan and Russia that the highest e-government development index is observed.

5. Discussion

Digital transformation trends are an inevitable process that occurs everywhere. Failure to follow it threatens the state with the decline and destruction of all economic and social ties, both domestically and internationally, rendering such country simply not competitive. The analysis suggests the positive dynamics of the digital transformation process not only in the economic context, but also in the social context for all EAEU member countries. From year to year there is an increase in indicators related to the availability of conditions for the development of ICT, the readiness of citizens, business circles. Notably, the union assumes, as an integration association, the joint work of the participating countries in the direction of both economic development and social development and other processes. However, it should be noted that due to the heterogeneous infrastructural and economic development of the countries themselves, there is a gap between different regions within countries, and, first of all, there is a significant difference in the level of digitalization of the urban and rural environment. Both within the framework of digital transformation and based on the trends that are occurring in each EAEU member country, the union needs joint digital projects. This opinion is also confirmed by the specialists of the Eurasian Economic Commission (Eurasian experts on the EAEU..., 2019). According to experts, uniform standards and rules for joint digital projects are required. Also, experts of the Eurasian Commission note the shortcomings

regarding the consolidation of the EAEU member states. As for this statement, there is a need for countries to focus on science and technology (which concerns all countries of the union, without exception) and it is necessary to unite forces in this aspect. However, integration projects and their implementation will require certain investments (source of own income) (Kokkinou et al., 2018). In this situation, it is possible to direct the work of the Eurasian Economic Commission to expand the format of cooperation, to more intensive interaction with business structures, to create projects and for business, both medium and small.

One of the problems in the development of the digital transformation of the union is legislation, namely, differences in the national context. The solution to this problem is seen in the possibility of applying the practice of implementing supranational regulation at the national level, converging regulation. This will give more competences to the EEC (Eurasian Economic Commission), and make it more effective, which is also conditioned by the possible transfer of the function of control over the implementation of national decisions, provisions and rules, which in turn can increase discipline within the Union. There should be the implementation of solutions and the promotion of initiatives that countries can offer to the global community, and special attention should be paid to the digital transformation. The above statements are supported by other experts of the Eurasian Economic Union, as well as experts from the World Bank (Gurov, 2019), who developed key recommendations for the implementation of the Digital Agenda until 2025, which is based on the conducted studies of risks, threats and prospects for the digital transformation processes of the member countries of the Union.

To create an effective process of digital transformation in the socio-economic context of the EAEU countries, it is necessary to synchronise the legal framework and institutional in the general set of ongoing complex measures. It is imperative to ensure the proficiency in digital literacy of the population, taking into account the technological development, as well as the territorial component. Accordingly, there is a need to develop programmes aimed at increasing the digital skills of the population. Due to the territorial peculiarities of the member countries of the union, it is necessary to support the development and implementation of digital platforms, which is possible in the implementation of joint projects. All this will also require the development of a certain funding mechanism, as already noted earlier, with the possibility of attracting the business environment.

6. <u>Conclusions</u>

The conducted research allows to draw generalising conclusions. Digital transformation is understood as the introduction of modern digital technologies into the business processes of companies and other business entities, allowing not only to change the quality, but also to create a new one. This entails not only the installation of modern equipment, but also the need for fundamental changes in management, external communications, and corporate culture. This process enables the company to gain a reputation for being a modern and progressive organisation, increase customer satisfaction, and improve employee productivity. In the aggregate of all enterprises in the country, this leads to a digital transformation of the industry and the entire economy of the country, the national level is affected, accordingly, the requirements for certain knowledge of technologies and software lead to an increase in the digital transformation of society. In this situation, a digital transformation can be traced, both in the economic and the social contexts since most of all social spheres have also undergone digitalisation.

An analysis of the digital transformation in the socio-economic context of the EAEU countries showed positive trends with regard to business structures (economy), positive trends are also observed on the part of the population. However, due to the territorial complexity of the EAEU countries, there is a certain gap in information and communication literacy of the population and the development of technologies (urban and rural population). The author's position on ways to solve problems is that currently the process of digital transformation of the economy opens unique opportunities for manufacturers in different countries. However, it is necessary to develop human potential and education to get closer to the leaders of the world economy. It is necessary to introduce information and communication technologies (ICT) in all spheres of the economy and human life. This situation requires not only refinement and

integration in relation to the legal framework, but also institutional changes. The joint work of the member states of the Union is necessary to implement joint projects in this direction. Furthermore, for implementation, it is necessary to develop a financial mechanism with the involvement of the business community.

In this situation, a "patchwork" approach to the development, implementation and use of digital technologies will not help to obtain significant benefits for the economies and society of the EAEU countries. It is necessary to develop and study these areas, considering specific national features that require systematisation, generalisation, and development of scientific opinions on the digital transformation of the national economy.

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MODELING LOGISTIC ENTERPRISE RE-LOCATION DECISION BY A NESTED LOGIT MODEL

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Abstract

This paper develops a model to analyze decisions regarding the relocation process for logistics enterprise by using nested logit model. In this framework, two decision points in the relocation process are assumed and maintained in the micro-simulation modeling. The first decision, move or non move and the second decision, choosing the destination location. This study applied the relocation decision structure of each logistics enterprise by nested logit model to find out the best model.

In case study, the logistics enterprise relocation decision model has acceptable performance by the nested logit model. However, the nested logit model has to follow the IID Gumbel distribution holds within each nest. Therefore, nested logit model cannot take into account the various tastes among alternatives in the random part of utility function to improve the implementation of the model.

The results indicate that big logistics enterprises have a lower probability of relocating and the migrating enterprises are more attractive in the zone which has a high accessibility. Finally, the population density, number of employees and the average land prices of zone strongly affect on the relocation decision making process of individual logistics enterprises.

Keywords: Logistics Enterprise, Re-location Decision Model, Nested Logit Model

JEL classification:

1. Introduction

Most logistics enterprises must constantly adjust themselves to new and changing circumstances to survive in a competitive business environment. Relocation of an individual logistics enterprise can be considered as a form of the adaptation (Brouwer et al. 2004). Pellenbarg *et al.* (2002) defined enterprise relocation as a change of address of an individual enterprise from this location to the other location. The factors influencing a logistics enterprise's propensity for moving are internal factors such as number of employee, floor area, transportation costs, and so on; external factors including the number of companies in market, population density..; and location factors such as average land price of location, distance between location and the IC highway. (see more, e.g. Van Dijk and Pellenbarg, 2000; Brouwer et al. 2002). This research, therefore, analyzes the influence of these factors on relocation decision behavior of logistics enterprise in order to better understand the key factors.

There have been a number of studies concerning the issue of relocation decision making behaviors of an individual firm or household, which is also discussed in these papers (see, e.g. Charles, 1979; Van Dijk et al. 2000; Leitham et al. 2000; Wissen, 2000; Brouwer et al. 2004; Holguín-Veras et al. 2005; Clifton et al. 2006; Ozmen-Ertekin et al. 2007; Xiang Cai. 2018; Alexiadis, S. 2020). However, very little research has been done concerning a model for individual logistics enterprise' relocation decision by means of a nested logit model. Therefore, the objective of this paper is to present a nested logit model to analyze logistics enterprise's relocation decision making behaviors in order to better understand the key factors that influence the decisions made by logistics enterprises as to where they relocate in metropolitan areas.

2. Literature review in Nested Logit Models

Waddell (1996) considered the interaction of workplace, residential mobility, tenure and location choices. In his research, the model is on the basis of the description of a household's location choice as a bundle of choices which consist of the decision to move, and the subsequent selection of a housing tenure and location. One motivation for the treatment of mobility and location choice as separate but linked choices is that he intends to model marginal changes in residential location as a function of changes over time in household characteristics and location characteristics, including such policy-relevant factors as accessibility and housing prices. His model is conceived as a dynamic adjustment to changing conditions, rather than as a cross-sectional static or equilibrium solution.

Zondag *et al.* (2005) analyzed the importance of accessibility in explaining residential relocation choice. They proposed the detailed structure of the housing market module which illustrated the various steps at the demand side of the housing market. First, a household makes a decision to move or to stay. Once, a household has a decision to move this household to enter the residential location choice module. The residential location choice module consists of a nested structure which includes the first level is a household chooses a region and the second level is a specific zone within a region. Their research results suggested that the significant role of accessibility but rather small compared to the effect of demographic factors, neighborhood amenities and dwelling attributes, in explaining residential location choices.

Holguín-Veras *et al.* (2005) placed their concentration on studying the problem of the business relocation and applied both the aggregate and disaggregate approaches taking account of the fundamental geographic models of business relocations, and an econometric investigation of the role of the transportation accessibility in the process of the business relocation. The disaggregate approach applied in their study is involved in the development of the multinomial logit (MNL) models representing the decision to choose an alternative among a set of the aggregated alternatives.

In the research process, however, less attention has been given to the use of a Nested logit model. As described above, in previous research efforts, the debate focused on a model for residential location choice in urban areas. Very little research, however, has been conducted regarding a model for relocation choice for logistic firms using a Nested logit model. Therefore, the objective of this paper is to present a Nested logit model for the analysis of relocation choice behavior in order to better understand the key factors that influence the decisions made by logistic firms as to where they relocate in metropolitan areas.

3. Study Methodology

3.1. Conceptual Framework of Re-location Choice Models

In reality, the logistic enterprise or household relocation behavior decision process is very complex. This process has been separated into many steps from one more step up to seven steps in the many previous researches. Nevertheless, the most common relocation choice process has been chosen for this research. Therefore, the logistic enterprise relocation model of the proposed model is assumed to include two steps such as move/stay decision and location choice decision in this research.

The relocation decision process is considered by the nested logit model. Firstly, the individual logistic enterprise makes a decision to move or to stay. One, an individual logistic enterprise has a decision to move this individual logistic enterprise to enter the zone choice decision.

3.2. Proposed Re-location Models Structure

This paper proposes the logistic enterprise process that consists of two levels, namely, (1) moving probability, and (2) location choice probability.

The proposed model structure can be drawn as the following chart which shows clearly in Figure 1.1. For each individual firm *n*, the relocation process is assumed to consist of two levels, namely (1) move/stay, and (2) zone choice decision.

Figure 1.1 Re-location Models Structure
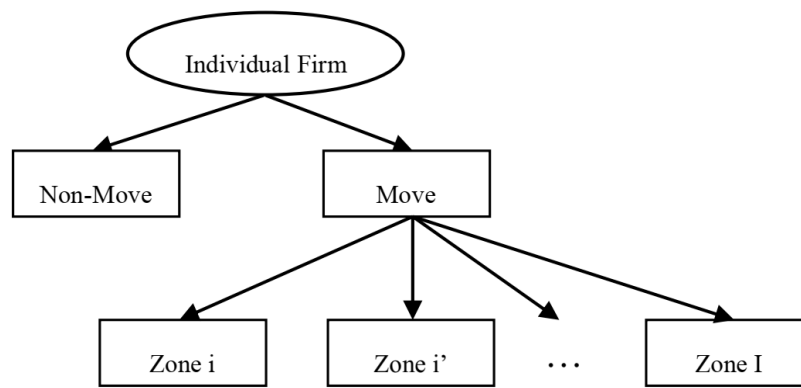
The joint decision of firm *n* to move and to relocate to zone *i* is assumed to the product of the probability firm *n* that will move and the conditional probability that firm *n* chooses location *i*. The probability of relocation decision of individual firm can be expressed as follows:

$$P_n(i) = P_n(m) \times P_n(i/m)$$

Where,

$P_n(i)$ = probability firm *n* will relocate and choose zone i;

$P_n(m)$ = probability firm *n* will move;

$P_n(i/m)$ = probability that firm *n* chooses zone *i* after deciding to move;

n =1,…, N with N= the total number of firms.

3.3. Re-location Models by Nested Logit Model

In this study, the moving decision of each individual logistic enterprise and location choice are assumed to be two related steps of the individual firm relocation choice process that can be modeled jointly by using a nested logit (NL) structure. The two-tier nested structure of (Lee et al. 2010) for residential mobility and location choice has been utilized to explain the relocation decision of an individual logistic enterprise. Some notes are utilized in the structure of logistic enterprise relocation model by nested logit model.

The mathematical formulation of this model follows the utility maximizing NL model developed by McFadden (1974), as described by Koppelman and Wen (1998), but with an additional sampling correction procedure added to ensure consistent estimation of the model parameters using a subset of alternatives. The probability of an individual firm choosing zone *i* is defined as follows:

$$P^n_z = P^n_{z/m} P^n_m$$

Where,

P^n_z = the probability of firm *n* will relocate and choose zone *z*;

P^n_m = the marginal probability of an individual firm *n* choosing move;

$P^n_{z/m}$ = the conditional probability that firm *n* chooses zone *z* after decided to move;

n = 1,…, N with N= the total number of firms.

First level: the bottom level conditional choice probability is equivalent to the standard multinomial logit (MNL) equation (Lee et al. 2010) and has the form as follows:

$$P^n_{(z/m)} = \frac{\exp(\mu_z V^n_{z,m})}{\sum_{k=1}^{I} \exp(\mu_z V^n_{k,m})}$$

Where,

$V^n_{z,m}$ = the observable components of the utility function for each elemental alternative z;

μ_z = the associated scale parameter.

There is no correction that is needed here as it has been shown that the standard MNL form produces consistent estimates of the model parameters due to the IIA property when the simple random sampling strategy is used to draw a subset of zones (McFadden, 1978). In addition, the other researches also mentioned other sampling strategies which include independent importance sampling or stratified importance, different additional adjustment terms as described in Ben-Akiva and Lerman (1985) are needed to correct for sampling bias. The marginal choice probability of an individual firm for choosing move decision can be expressed as follows:

$$P^n_m = \frac{\exp(\mu_m V'_m)}{\sum_{m'}^{M} \exp(\mu_{m'} V'_{m'})}$$

Where,

V'_m = the logsum (or inclusive value) associated with moving nest m and μ_m is the top level scale parameter.

The logsum represents the expected value of the maximum of the random utilities of all zones in moving nest m (Lee et al. 2010). In addition, the logsum equals the log of the denominator of the conditional probability multiplied by $1/\mu_z$ in a standard NL formulation with full enumeration of all variable zones. The logsum can be written as following formula.

$$V'_m = (1/\mu_z)\left[\sum_{z' \in Z_m} \exp(V_{z'} \mu_z)\right]$$

In this case where a subset of elemental alternatives at the bottom level was sampled from the universal choice set, the denominator of the conditional probability must be adjusted in the calculation of the logsum. The Slutsky theorem (Ben-Akiva and Lerman, 1985) which states that a continuous function of consistent estimates is also consistent, an expanded logsum may be used as a consistent estimate of the logsum derived from the full set of alternatives. The expanded logsum for a simple random sampling can be written as follows:

$$V'_m = (1/\mu_z)\left[\sum_{z' \in Z_m} \left\{(1/R)\exp(V_{z'} \mu_z)\right\}\right]$$

Where,

R = the sampling rate, $0 < R < 1$, which only applied to the sampled non-chosen alternatives.

Regarding with the two unknown parameters, μ_z, or μ_m, only one of them or the ratio between the two can be identified in the model estimation. It is a common practice to normalize one of the parameters to equal one and estimate the other (Ben-Akiva and Lerman 1985). Following the approach described in Koppelman and Wen (1998), μ_z is set to one here. In this case, μ_m must be between 0 and 1 as a condition of consistency. As the coefficient of the logsum, the parameter μ_m can be interpreted as an indicator of the hierarchical nature of the nesting structure. If the estimation of this parameter approaches 0, the decision process is considered to be strictly hierarchical. Whereas, if μ_m equals one, then the two choices are considered independent and the NL model decreases to a single-stage MNL model. In the case where there is only a single alternative in a nest, that nest is considered degenerate and μ_m equals one Lee et al. (2010). If there is only a single alternative in every nest of the individual firm relocation process structure, then the NL model of this structure also collapses to the MNL model of zone choice decision. In addition, the meaning

of log-sum coefficients can be expressed as follows: (See more Ortuzar and Willumsen, 1994). If the value of log-sum coefficient is less than 0, an increase in the utility of an alternative in the nest, which should increase the value of expected maximum utility, would actually diminish the probability of selecting the nest. If the value of log-sum coefficient is equal to 0, such an increase would not affect the nest's probability of being selected, as an expected maximum utility would not affect the choice between move decision and non-move decision. If the value of log-sum coefficient is higher than 1, an increase in the utility function of an alternative in the nest would tend to increase not only its selection probability but also those of the rest of the option in the nest. Finally, if the value of log-sum coefficient is equal to 1, the hierarchical logit model becomes mathematically equivalent to the MNL. In such cases, it is more efficient to recalibrate the model as an MNL, as the latter has fewer parameters (Ortuzar and Willumsen, 1994).

4. Data Collection for Case Study

The input, output, and data source in each of the models are summarized in Table 1.1 in the case study of the proposed model. With regard to the data source of the move/stay decision, the distance from the current location of individual firm to the nearest IC highway and the average land price of current location were collected from the survey A and D of TMGMS. The number of employees of the firm and the floor area also was collected from the survey D of TMGMS. For the data source of the zone choice decision, the number of employees of the firm was collected from the survey D of TMGMS. The number of the population of a zone was collected from the population census of Japan. The number of firms of zone and the number of employees of the zone was collected from the establishment and the enterprise census (EEC). In addition, the accessibility of each zone was calculated based on the accessibility formula of Allen *et al.* based on the average travel distance of each zone which can get from the RTC. The average land price of a zone can be computed from the land price survey of Japan. The average distance between zones obtained from the empirical data is used as the zonal impedance variables in this research.

Table 1.1 Input, Output, and Data Source in Logistics Enterprise's Relocation Model

Model		Input	Data source	Output
Re-location Model	**Move/stay Probability**	- The number of employees of each firm. - The floor area of each firm - The land price of the current location of each firm. - The distance from the current location of each firm to the nearest IC Highway	Survey A and D of TMGMS	Probability of moving decision.
		- Dummy variables of destination characteristics	Survey D of TMGMS	
		- The weight of commodity per day and the travel distance from firm to customers - Transportation cost	Survey B of TMGMS	
	Zone Choice Probability	- Average land price of zone	Land price survey	Probability of a zone being selected.
		- Number of firms of zone	EEC	
		- Population number of a zone	PCJ	
		- Total area of zone	GIS	
		- Employees number of firm - Floor area of each firm	TMGMS	
		- Accessibility of each zone - Distance	RTC	

5. Results and Discussions

Table 1.2 shows the results of individual firm relocation decision by nested logit model. The nested logit model of individual firm mobility and location choice has a relatively parsimonious specification but it, nevertheless, includes the important exploratory variables that are expected to be an integral part of the individual firm relocation decision process. The model has an acceptable good fit based on the value of log-likelihood ratio and AIC test, which are shown at the end of Table 1.2 are 0.267, 0.176 and 0.149 for chemical manufacturers, machinery manufacturers and retailers, respectively. In addition, the model gives the same sign of the estimated parameters, each of which is as expected. For example, the average land price of each zone has a negative effect on the individual firm location choice decision as it's intuitive that an individual firm tends to locate in the zone with lower land price. Next, as we expected that the number of employees of each individual firm has negative sign. This means that the large firms or big firms have a lower mobility of re-locating.

Regarding with the logsum of nested logit model, the logsum value can be considered as the links between the two levels of the nested logit model by bringing information from the bottom level into the upper level. Therefore, the logsum coefficient reflects the degree of independence among the unobserved portions of utility for alternatives the moving nest. Note that the probability of choosing moving nest in the first level depends on the expected utility that the individual firm receives from choosing that nest. This expected utility is made up to the utility that an individual firm receives no matter which zone an individual firm chooses in the moving nest. The expected extra utility that an individual firm receives from being able to

choose the best zone in the moving nest, which is the multiple between logsum value and logsum coefficient (see more, Wen, Chieh-Hua & Frank S. Koppelman.2001, Vovsha, Peter.1997, and Heiss, F. 2002, Matt Golder).

In this research, the log-sum coefficient showing a degree of independence in the unobserved parts of utility for alternatives in a nest, and the estimated logsum parameters of the move nest are 0.0455, 0.2592 and 0.3664 for chemical manufacturers, machinery manufacturers and retailers, respectively. Therefore, the low values of the log-sum coefficients mean that an increase would affect slightly on the probability of the move nest of being selected, as the expected maximum utility would affect slightly on the choice between move decision and non move decision.

Table 1.2 The Estimation Results of Logistics Enterprise Re-location Decision by Nested Logit Model

Variables	Chemical Manu	Machinery Manu	Retailers
	Coefficients (*t-value*)	Coefficients (*t-value*)	Coefficients (*t-value*)
Zone choice			
Average land price of zones (1,000 yen/ m^2)	-0.0042(-3.37)	-0.0085(-3.23)	-0.0029(-4.94)
Population density of zones (in 1,000 persons/ km^2)	0.0079 (2.30)	0.0023 (1.52)	0.0016 (1.28)
Number of employee of zones (in 1,000 persons)	0.0731 (2.01)	0.0402 (3.12)	0.0230 (0.76)
Distance (1,000 m)	-0.0006 (-1.72)	-0.0002 (-1.11)	-0.0017 (-1.15)
Number of employee of firms (in 1,000 persons)	-0.0734 (-0.85)	-0.0212 (-0.47)	Omitted*
Distance from firm to IC Highway (1,000 m)	0.0111 (2.40)	0.0047 (1.43)	0.0012 (0.69)
Move/stay choice			
ASC_move	-0.0793 (-3.62)	-0.2704 (-1.71)	-0.3119 (-1.42)
Land price of current location of firm (1,000 yen/m^2)	0.0016 (0.96)	0.0022 (1.45)	0.0036 (0.98)
Transportation Cost (10,000 yen)	0.0015 (1.37)	0.0013 (1.35)	0.0004 (0.82)
Firms need for large land (Yes =1, No =0)	0.0378 (0.83)	0.0118 (0.69)	0.0148 (0.41)
Firms need to be near to major customers (Yes =1, No =0)	0.0455 (1.07)	0.0816 (1.21)	0.0211 (0.97)
Firms need to be convenient for employees to commute (Yes=1, No = 0)	-0.0109 (-2.35)	-0.0106 (-1.24)	Omitted*
Firms need to be available for land to expand area (Yes =1, No =0)	0.5854 (0.89)	0.7054 (1.86)	0.0499 (1.31)
Firms have problems about loading and/or unloading (Yes =1, No =0)	0.1714 (1.59)	0.0943 (0.78)	0.0116 (0.47)
Firms have problems of parking space (Yes =1, No =0)	-0.6417 (-0.65)	-0.8595 (-1.23)	-0.0710 (-1.45)
Move nest logsum μ_m	0.0455 (3.62)	0.2592 (3.91)	0.3664 (2.06)
Number of observation	571	659	519
Log-likelihood at convergence	-1652.5	-2144.2	-1743.7
Log-likelihood at zero	-2256.1	-2603.8	-2050.6
Log likelihood ratio	0.267	0.176	0.149
AIC test	5.85	6.55	6.77

The estimation results of the nested logit model arrange in a line with those found in previous empirical studies (Lee et.al 2010). Number of employee, floor area, distance between the current location to the nearest IC highway, transportation cost and land price of current location of each individual firm, the demand to get a large land, need to be near to customers or major customers, need to be near IC highway, and need to be convenient for employees to commute, the pressures of many problems such as loading and unloading at road in front of firms, parking space were determined to be important individual firms' characteristics which helped to explain the individual firm's mobility and zone choice decision making process with the important attractiveness of zones. In general, large firms or

big companies are less likely to move and change location than the small firms with high land price of current location and transportation cost.

Even though, the individual firm relocation decision model has acceptable performance by the nested logit model. However, the nested logit model has to follow the IID Gumbel distribution holds within each nest (Ben-Akiva et al. 1985). Therefore, nested logit model cannot take into account or considering the various tastes among alternatives (zones) in the random part of utility function to improve the implementation of the model. It means that the nested logit model has some disadvantages to deal with the incorporating spatial interactions among zones in the error part of utility function in the individual firm zone choice decision model.

6. <u>Conclusions and Recommendations</u>

This research has analyzed the relocation decision structure by using nested logit model. In this results, the t statistic values of most variables are acceptable in the nested logit model. However, the nested logit model has to follow the IID Gumbel holds within each nest (Ben-Akiva et al. 1985). Therefore, nested logit model cannot take into account the correlation among alternatives (zones) in the random part of utility function.

The future research must overcome the limitation of survey data which include a little information of the characteristics of individual firm, firm current location, previous location and attributes of zones, such as the age of firm, the age of building, the distance building to the nearest station, IC highway or previous location, land price of firm in building,… In addition, the present results can be valuable for further research into simulation modules for the relocation decisions for firms in an integrated land use and freight-transport modeling environment.

The firm relocation model consists of two decisions is very popular in the literature review. In fact, there are some structures of firm relocation models and each this structure corresponds with each different purpose of each individual firm. For example, the individual firm relocation structure consists of two decisions, three decisions, four decisions or five decisions. Therefore, the results of this research still open for the future researches which want to study on the individual firm relocation models. The obtained results still leave ample room for improvement because the present study is limited to a small data set for the estimation and common structures. It is expected that the better model performance will be achieved with an improved, larger set of data and specific structures. In addition, the influence of spatial effect on the location choice decisions by incorporating spatial effect on the deterministic part of utility function by nested logit model is a related subject in the future research.

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IMPACT OF SERVICE AND E-SERVICE QUALITY, PRICE AND IMAGE ON THE TRUST AND LOYALTY OF THE ELECTRONIC BANKING CUSTOMERS

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Abstract
In the era of globalization and increasing competition worldwide, banks are changing their strategies in order to reach customers around the world easier and cheaper. Banks have adopted modern technology to reduce costs and improve the quality of customer service as well as provide standardization of basic services. Albania has been a positive trend in the use of e-banking and the Internet as a new alternative for providing banking products and services. The purpose of this study is to measure the impact of service quality, quality of e-service, price factors and image have on the trust and loyalty of customers to banks and present some conclusions in order to improve the e-banking situation in Albania. The study is based on primary data collected from the administration of 400 questionnaires in three districts of Gjirokastra region. Data were analyzed using classical econometric models (linear multifactorial regression). From the multivariate analysis, used to see the relationship between trust and service quality, e-service quality, price and image, it resulted that e-service quality, image and price are important factors influencing customer trust, while quality of service does not appear to be statistically significant. All four of the above factors were taken into account to see their relationship with loyalty to banks. Multivariate analysis showed that all four factors are statistically significant in their impact on loyalty. These findings constitute a valuable contribution to the financial institutions, financial advisors, bank customers and prospective applicants.
Keywords: trust, loyalty, image, service quality, quality of e-services
JEL classification: E5

1. Introduction

Nowadays e-banking has become an integral part of modern banking due to lower transaction costs, twenty-four hour services, increased control over transactions, higher transaction volume in less time, of remote transaction facilities, and a much wider group of banking products and services. Internet technology has changed the design and manner of financial services and as a result the banking industry has made continuous innovation and leading ultimately to the idea of what is known as "online banking".

In real use of the Internet as a new alternative channel for the distribution of financial services has become a competitive necessity rather than just a way to achieve competitive advantage with the advent of globalization and fierce competition (Flavian, C., Torres, E., and Guinaliu, M. (2004); Gan, C and Clemes, M. (2006). Basically electronic banking involves the use of electronic means to transfer funds directly from one account to another. E-banking has brought about an evolution in the banking system, because it has become possible "creation" of a bank branch in everyone's home and is destined to develop further.

Compared to traditional banking, e-banking is a free and direct way to perform banking operations. There are many benefits of e-banking, such as simpler monitoring of bank accounts, buying and selling goods and services, paying various bills, participating in auctions, e.g. Amazon.com and E-Bay, money transfer from any place and at any time, cost reduction (MPCS, 1998; Sathye, 1999), time saving, etc.

Other benefits of e-banking include: no restrictions and barriers, but it is very convenient, services are provided at minimal cost, it has transformed traditional practices in the banking

sector; the only way to stay connected with customers in any country and at any time is through internet applications, it results in high performance in the banking industry through fast delivery of information from the consumer and service security; customers prefer using e-banking, because it saves time, makes it possible to use new products and services with lower tariffs on transactions and encourages the rotating management which is one of the most important dimensions of service quality in e- banking (Gonzalez et al, 2008; Singhal and Padhmanbhan 2008; Brodie et al,2007; Williamson, 2006, Beer, 2006; Cooper, 1997; e IAMAI, 2006 and Jozefi et al, 1999).

2.   <u>Literature review</u>

The use of electronic banking service by banks in recent years has been the center of many academic studies (Andreas - Nicholas Papandreou 2006). The focus of academic studies have undoubtedly been reasons or factors that make it necessary for such a development which no doubt can be called "historic" and may constitute a separate phase in the history of banking operations. Over the last ten years there has been a lot of research which has studied a large number of factors that affect the purpose of consumers to use internet banking. In the context of e-banking, literature review allows us to identify the factors that influence customer attraction in the use of e-banking.

Stewart (1999) argued that despite the advantages of e-banking is possible and that his failure was attributed primarily to a lack of trust of customers to electronic channels.

It is very difficult to analyze trust as a phenomenon and it can be almost impossible to analyze trust in the context of e-commerce due to the complexity and risk of e-commerce. Trust will be the deciding factor in the success or failure of e-banking. It is difficult to build an effective electronic payment system without having full confidence in banks, as customer deposits are a necessary component for this system to work.

Sathye (1999) and Polatoglu and Ekin (2001) found that the reliability dimension was an important determinant for customers who used electronic banking. Moreover, Sathye (1999), and Liao & Cheung (2002) have found that trust was positively associated with the use of electronic banking services. They reached the conclusion that the more confidently customers percept electronic banking service, the more possible it is that they will use electronic banking. Sadeghi and Hanzaee (2010) made up a model with seven factors as follows: comodity, accessibility, correctness, safety, necessity, bank image and website design, considering them as main indicators of quality perception of e-banking service by customers. Also, Yap, K et al. (2010) focused on the quality of traditional services and the features of the internet and their impact on building customer trust in e-banking.

The quality of electronic banking system services should become an important area of attention among researchers and bank managers due to the impact on business performance, lower costs, customer satisfaction, customer loyalty, and profitability (Seth et al., 2004).

2.1. Service quality

The most important factors influencing the selection of banks are the quality components of the services. All banks offer almost the same services, but to distinguish between banks we must note how these services are provided. Dabholkar et al. (1996) found that service quality is multidimensional. They found the direct impact of customer perceptions on performance levels on service quality, and that customer personal characteristics are important for value assessment. Studies from the service literature have highlighted the importance of quality perceptions and the relationship between service satisfaction and quality (e.g. Cronin and Taylor, 1992; Taylor et al, 1994). However, there is no evidence to suggest that service quality leads to customer satisfaction and helps to retain existing customers and attract new ones (Keiser, 1993; Lian, 1994a, b).

Nowadays, banks have tried to increase their performance that goes beyond service quality. They suggest what they call "service excellence" (Mahoney, 1994). Marsden (1993) suggested perfect service as an area with which firms can satisfy their customers and exceed their expectations. This has stimulated many manufacturing and service businesses to adopt programs such as TQM (total quality management) or CQI (continuous quality improvement) (James, 1989; Joseph, 1996).

In addition, measuring and evaluating the quality of services in the field of banking, including the banking industry has become very important due to changes in the banking environment. Banking has become more integrated globally, there is high competition but still, it is important for banks to know how their customers will perceive products and services.

2.2. E-Service quality

The quality of e-service is one of the key factors determining the success or failure of e-commerce (Santos 2003). Nowadays advances in information technology play a vital role in business. This has provided a completely new look to expand the range of products and services offered by Internet use. In addition, the emphasis is on building and maintaining customer relationships as the key to success in being competitive in e-commerce, which depends on the effective delivery of e-service quality. The banking industry today is moving towards providing integrated financial services due to strong competition and rapid technological change. Albanian banks are trying to think strategically by offering high quality products and services to satisfy their customers. Albanian banks consider these changes and try to apply new technologies to gain more market share by using the quality of E-service from the website by offering different types of services such as checking accounts and statements, transferring funds. , placement of fixed deposits, payment of bills, credit cards, loans and insurance payments, application for bank drafts and telegraphic transfers.

Kaynama and Black (2000) based on traditional SERVQUAL dimensions built a model to measure the quality of seven-dimensional service: pleasure, access, navigation, design, feedback, background, and personalization. Zeithaml (2002) develops a framework consisting of eleven dimensions used in the evaluation of e-service quality delivery which include: access, convenience, efficiency, flexibility, reliability, personalization, security, accountability, trust, aesthetics of the website and price knowledge.

2.3. Image

The image is described as an attitude (Hirschman et al, 1978). Moreover, Kennedy (1977) noted that the image has two main components, functional and emotional. The functional component is related to the tangible dimensions that can be easily identified and measured, while the emotional component is related to the psychological aspects that are the process by which customers compare the different qualities of firms (LeBlanc and Nguyen, 1996, and Nguyen and LeBlanc, 2001).

According to Kang and James (2004), a favorable and well-known image is seen as a valuable asset and in many respects the image has an impact on customers perception of the firms communication and operations. Kang and James (2004) explained that if a customer has a positive image towards the service provider, they tend to forgive the small mistakes made by the service provider.

2.4. Trust

Morgan and Hunt (1994) stated that trust exists only when one party has confidence in the trustworthiness and integrity of the other party. Doney and Cannon (1997) also added that the partner should also have the ability to continue to meet his obligations to customers within the cost-benefit relationship; so, the customer must not only anticipate positive outcomes but also believe that these positive outcomes will continue in the future. Researchers had focused on the essential role of trust in building and maintaining long-term relationships (Rousseau et al, 1998; and Singh and Sirdeshmukh, 2000).

This is also known in marketing theory as the basic policy in developing and maintaining long-term relationships (Crosby et al, 1990; Ritter, 1993; and Doney and Canon, 1997).

2.5. Loyalty

Loyalty is considered one of the keys to achieving company success and sustainability over time (Keating et al, 2003). Loyal customers are less likely to switch to another competitor due to price incentives, and these customers results to make more purchases than

less loyal customers (Baldinger and Rubinson, 1996). An American study concluded that more than 37 percent of the variance observed in customer loyalty levels was explained by satisfaction levels. Given the growing competitiveness of many industries, customer loyalty is perceived as a key factor in gaining and maintaining market share, moreover, customer loyalty is a key determinant of firms long-term financial performance.

Albanian Banks must provide customers loyalty to achieve stable financial growth and improve their position in the market. They need to develop strategies to ensure increased customer satisfaction and loyalty by improving service quality, if loyalty increases this can lead to significant profit growth. Moreover, customers will stay loyal to their banks when there is an increase in the level of satisfaction. For this, we consider the vital role of customer satisfaction in customer relationships and the positive impact on loyalty.

3. Purpose and study objectives

The purpose of this study is based on the current state of e-banking in Albania to measure the impact that service quality, e-service quality, price factors and image have on customers trust and loyalty to banks. In view of the above purpose, the paper has as its main objective:

Measuring the impact that the quality of service, the quality of e-service, price factors and image have on the trust and loyalty of customers to banks (with a focus on the Gjirokastra region).

4. Hypothesis and methodology

The decision to use electronic banking services is a function of several variables (measured in 7 degrees according to Likert) and personal characteristics. Variables will include: trust, loyalty, service and e-service quality dimensions, price and image.

To address research problems and achieve the main objective, this study will confirm the following hypotheses:

Study hypotheses

Hypothesis 1: Trust does not depend on service quality, E-service quality, price factors and image

Hypothesis 2: Loyalty does not depend on service quality, E-service quality, price factors and image

To achieve the purpose and objective of the study was conducted a questionnaire in three districts of Gjirokastra region. Based on statistical methods and classical econometric models (linear multifactorial regression), the survey data were processed and findings the confirmations or not of the hypotheses were presented.

5. Data analysis and findings

To measure the impact of service quality, e-service quality , price factors and image have on the trust and loyalty of customers to banks was used classical econometric models (linear regression multifactorial). Table 1 presents the information of sample composition by personal factors.

Tabela 1: Sample by personal factors

	Frequency	Percent
A. PERSONAL FACTORS		
1. Gender	**350**	**100.00 %**
a) Female	186	53.14 %
b) Male	164	46.86 %
2. Age	**350**	**100.00 %**
a) below 18 years old	5	1.43 %
b) 18 -25 years old	88	25.14 %
c) 26 -35 years old	97	27.71 %
d) 36 -5 years old	68	19.43 %
e) 46 -55 years old	64	18.29 %
f) More than 56 years old	28	8.00 %
3. Marital status	**350**	**100.00 %**
a) Married	195	55.71 %
b) Single	132	37.71 %
c) Widowed	8	2.29 %
d) Divorced	15	4.29 %
4. Education level	**350**	**100.00 %**
a) Low education	13	3.71 %
b) Secondary Education	96	27.43 %
c) University education	211	60.29 %
d) Postgraduate education	30	8.57 %
5. Area of residence	**350**	**100.00 %**
a) Urban areas	287	82.00 %
b) Rural areas	**63**	**18.00 %**

Source: Developed by author

5.1. Regression Analysis

Hypothesis 1: Trust does not depend on service quality, E-service quality, price factors and image

Table 2: Summary of model for trust with the method of least squares

Dependent variable: **TRUST**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.529820	0.259301	-2.043262	0.0418
E-SERV. QUALITY	0.248655	0.066925	3.715413	0.0002***
SERVICE QUALITY	0.081202	0.073705	1.101718	0.2714
IMAGE	0.452139	0.049056	9.216745	0.0000***
PRICE	0.308942	0.038580	8.007726	0.0000***
R-squared	0.673883	Mean dependent var		5.338135
Adjusted R-squared	0.670090	S.D. dependent var		1.334388
S.E. of regression	0.766442	Akaike info criterion		2.320108
Variable	Coefficient	Std. Error		t-Statistic
Sum squared resid	202.0772	Schwarz criterion		2.375339
Log likelihood	-399.8589	F-statistic		177.7087
Durbin-Watson stat	1.985028	Prob(F-statistic)		0.000000

Source: Developed by author

Note: *, **, *** *** indicates that the results are significant at 10, 5 and 1 percent respectively.

The final model derived from the multivariable analysis appears as follows:

$$TRUST = -0.529820 + 0.248655 \text{ E-SERVICE QUALITY} + 0.081202 \text{ SERVICE QUALITY} + 0.452139 \text{ IMAGE} + 0.308942 \text{ PRICE} + \varepsilon$$

The value of the Durbin – Watson test results to be equal to 1.985028. This value is within the allowable range (1.5-2.5) and indicates that autocorrelation is not present in the model.

The above data show that the model as a whole is important because the statistics ($F = 177.7087$; Prob $F = 0.000000 < 0.05$). In this way we conclude that the elevated model is statistically significant based on the error of the first type $a = 0.05$ or at the 95% reliability level.

To measure the power of addiction of depended variable (faith), and independently variables included in the model (E- sercive quality, service quality, image and price) is considered the correlation coefficient R^2, corrected with the freedom scales. According to the statistics presented in the summary table of the model, it is noticed that 67% of the variation of the dependent variable is explained by the independent variables. The remaining 33% belongs to other factors (including random ones) that are not included in the model.

Among the four factors included in the model results that E-service quality, image, and price are statistically significant, while the service quality does not appear to be statistically significant. This is confirmed by the test values t and the probability p values that for each variable result respectively t of quality of E-service = 3.715413, p (t) quality of E-service = 0.0002 <0.05; t of service quality = 1.101718, p (t) service quality = 0.2714> 0.05; t of image = 9.216745, p (t) image = 0.0000 <0.05; t of price = 8.007726, p (t) price = 0.0000 <0.05. It is also noted that among the three statistically significant factors, results that the image has more impact, because according to the model, if the image improves by one degree then it is expected that the confidence will increase by 0.45 degrees.

Consequently, we can say that the above hypothesis is proven only for the quality of service with probability of at least 95%.

Hypothesis 2: Loyalty does not depend on service quality, E-service quality, price factors and image

Table 3. Summary of model for loyalty with the method of least squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dependent variable: **LOYALTY**				
C	-0.027608	0.276533	-0.099837	0.9205
E-SERV. QUALITY	0.171747	0.071373	2.406336	0.0166**
SERVICE QUALITY	0.388582	0.078603	4.943593	0.0000***
IMAGE	0.142923	0.052316	2.731900	0.0066***
PRICE	0.309358	0.041144	7.518847	0.0000***
R-squared	0.594323	Mean dependent var		5.363181
Adjusted R-squared	0.589606	S.D. dependent var		1.275915
S.E. of regression	0.817377	Akaike info criterion		2.448790
Sum squared resid	229.8280	Schwarz criterion		2.504020
Log likelihood	-422.3138	F-statistic		125.9913
Durbin-Watson stat	1.595233	Prob(F-statistic)		0.000000

Source: Developed by author

Note: *, **, *** *** indicates that the results are significant at 10, 5 and 1 percent respectively.

The final model derived from the multivariable analysis appears as follows:

$$\text{LOYALTY} = -0.027608 + 0.171747 \text{ E-SERVICE QUALITY} + 0.388582 \text{ SERVICE QUALITY} + 0.142923 \text{ IMAGE} + 0.309358 \text{ PRICE} + \varepsilon$$

In this model, the Durbin-Watson test results to be 1.595233, a value within the allowable range (1.5-2.5) and indicates that the assumption regarding autocorrelation has not been violated. Meanwhile, the variation of the dependent variable is explained by 58.96% of the independent variables taken in the model, because the adjustable coefficient of determination results in R2 = 58.96%, while 41.04% of the variation of the "loyalty" variable is explained by other random variables. in the model.

The data in the table above show that the model is statistically significant at the 95% confidence level ($F = 125.9913$; Prob $F = 0.000000 < 0.05$). If we analyze the importance of each variable included in the model (E-service quality, service quality, image and price), they are statistically significant so their effect on loyalty is valuable. This is confirmed by the test

values t and the probability p values that for each variable result respectively t of quality of E-service = 2.406336,   p (t) quality of E-service = 0.0166 <0.05; t of service quality = 4.943593, p (t) service quality = 0.0000 <0.05; t of image = 2.731900, p (t) image = 0.0066 <0.05; t of price = 7.518847, p (t) price = 0.0000 <0.05. Note also that among these four most important factors are quality of service and price, because according to the model, if the quality of service and price improve by one degree then it is expected that loyalty will increase by 0.388 and 0.309 respectively.

Consequently, we can say that the above hypothesis is rejected with probability at least 95%.

6. <u>Conclusions</u>

The purpose of this study is to show the impact that service quality, e-service quality, price factors and image have on customer trust and loyalty to banks in terms of using e-banking.

From the multivariable analysis used to analyse the relationship between trust and service quality, E-service quality, price and image, results that E-service quality, image and price are significant factors that impact the costumers trust and the service quality is statistically insignificant.

Among the three statistically significant factors, results that the image has more impact, because according to the model derived from multivariate analysis, if the image improves with a degree then it is expected that trust grows by 0.45 degrees. Our study is consistent with previous studies of Muhammed et al (2010) who found that image is a factor which positively impacts on the trust.

The forth above factors were taken into consideration to see their connection to bank loyalty. The multivariable analysis showed that the forth factor are statistically significant in their impact on loyalty. Note also that among these four most important factors are quality of service and price, because according to the model, if the quality of service and price improve by one degree then it is expected that loyalty will increase by 0.388 and 0.309 respectively. This finding reinforces the conclusion of Zahorik and Rust (1992) who have argued that service quality is a factor that affects customer loyalty. The results also support the study of Sirgy and Samli (1989), who reported a positive direct relationship between image and loyalty. Al-Khozam (2010), using the five main dimensions of e-service quality (ease of use, privacy, security, e-responsibility and contact), to measure their effect on customer loyalty found that there is no connection important between them as a direct link. According to the above study there is an indirect significant effect of e-service quality on customer loyalty mediated by satisfaction, image and trust. Also Al-Khozam (2010), using the five main dimensions of service quality (bank assets, reliability, accountability, security and sensitivity) to measure the effect of service quality on customer loyalty has found that there is no significant relationship direct between them, but has an indirect significant effect on customer loyalty mediated by satisfaction, image, and trust. According to Al-Khozam's (2010) study, it was found that there is an indirect effect of image on loyalty mediated by trust. Also Ball et al (2004) found that the image has about loyalty in a different way, it can affect loyalty through an indirect path from satisfaction and trust. Our findings support the following studies conducted, e.g. one study confirmed positive relationships between perceived quality of service and customer loyalty (Anderson and Sullivan, 1993; Cronin and Taylor, 1992). The study of (Murphy, 1996) proved that loyalty can also be determined by image. Tam, (2003) also proposed a model that explains customer loyalty where factors such as web design, security, privacy, and customer service have a major impact on customer loyalty. While the study of Brunner et al, (2008), in divergence with our findings found that image palys a much smaller role in terms of loyalty.

The results of this study show that banks should pay more attention to the quality of service, quality of e-service, image and price of banking transactions as important factors that affect the trust and loyalty of e-banking customers. This will help them not only keeping their existing costumers, but also will increase the number of new costumers.

7.   **References**

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ENVIRONMENTAL COOPERATION AS A WAY OF DEVELOPING ECO-TOURISM IN THE ARCTIC REGION

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Abstract

Tourism as a means of diversifying economic development can only be considered in those regions that have enough tourism potential. The application of tourism management methods in the region requires factoring in the specifics of the region itself and the possibility of increasing the number of inbound tourists. The relevance of the study is determined by the fact that the number of regions that can offer a competitive product is quite small and tourism is often their main income category. The novelty of the study is that the Arctic region is subsidized and often the region's economy is focused only on the extraction and processing of minerals. Attraction of tourists is limited due to climatic and infrastructural conditions. As a novelty of the study, the question of how to build infrastructure and provide a management model in the Arctic region is considered, provided that the model meets the standards of public administration. The practical application of the research results can be achieved on the condition that each of the participants in the public administration process can implement a regional development program at the level of the Arctic regions. The main task will be considered the process of formation of a competitive environmental and managerial environment upon financing with self-supporting forms.

Keywords: conditions for the development of tourism, the construction of tourist facilities, entrepreneurial activity in tourism activity, tourist demand, study programs at universities.

JEL classification: Q57, R11, Z32

1. Introduction

Over the past decades, the tourism industry has become one of the most profitable sectors of the global economy. At the same time, the Arctic region does not completely fulfil its tourism opportunities. Despite the positive dynamics of tourism development in the world, in the Arctic in 2016, the overall contribution of tourism to GDP decreased by 40% compared to 2012. A promising area for expanding international tourism services is ecological tourism. Every year, the number of environmental tourists in the world increases by 25%. In the

Arctic, ecological tourism is at an early stage of development and requires regulation by the state. There is an urgent need for a choice of regulatory impact measures. The basis for a balanced choice of these events is the assessment of the potential for the development of ecological tourism (Belitskaya, 2018).

At the same time, many issues related to the development of ecotourism activities require further research. Detailing the types and principles of the organization of ecological tourism requires elaboration, including the choice of measures of state regulation of this type of tourism activity. State regulation of the development of ecotourism includes a set of technical measures, which include certification. Certification of subjects of ecotourism will not only determine the quality of tourism services but will also enable the evaluation of the development potential of this type of entrepreneurial activity. The lack of research elaboration of these questions conditioned the relevance of the selected subject matter.

According to 11 programs of the federal project "Ecology", the Ministry of Natural Resources of Russia forms project offices. A special unit will be involved, among other tasks, in the development of eco-tourism. This direction has significant prospects. The sights of the Russian Arctic can attract many tourists, contribute to the economic development of the territories. So far, the development of the tourism industry in the Arctic reserves is hindered by logistical and legal difficulties, low transport accessibility of protected areas, lack of infrastructure, poor marketing, high cost of travel.

The relevance of the work is that investors for new projects in the tourism industry should be looked for among potential partners for whom tourism is the main type of their commercial activity. Specially protected natural areas of regional and federal subordination need equal conditions for the development of tourism. Tour operators who are willing to deal with the Arctic are interested in both types of territories. While the national parks have the right to attract extrabudgetary funding for the development of their projects, the regional state institutions do not.

Another significant problem is coordination and the most complex rules for the construction of tourist facilities. To make them profitable, large-scale investments and the joint efforts of many tour operators are needed. It is also necessary to develop competition among air carriers. Transport accessibility of territories can be increased with the help of hydroaviation. Of course, marketing research is important for the development of eco-tourism in the specially protected natural areas of the Arctic. It is important to understand how a territory is reflected in the mass consciousness, what stereotypes and myths impede the development of local tourism. It is important to build the tourism concept of a region based on existing meanings, legends, the search for new ideas and points of attraction that are attractive for tourists.

2.   <u>Literature Review</u>

Cooperation between states often takes a leading place in the implementation of programs for the development of the environment at large (Larionova et al., 2018). With the participation of the country in the general process of saving the planet from environmental disaster (Baboshkina et al., 2018), it is necessary to consider not only private, but also national interests that may be affected by the implementation of programs of holistic perception of the processes of territorial development. Activities within the framework of multilateral agreements with international organizations provide an opportunity to actively participate in the negotiation process, to attract financial assistance to solve pressing domestic issues (Vargas-Hernández and Pérez Martínez, 2016; Kruzhilin et al., 2018).

However, currently the researchers from different fields of scientific activity believe that global problems materialize in the form of risks that are multifaceted (Gribust, 2018; Provalova et al., 2019). For example, we see processes when stable societies become fragmented, which leads to a deterioration in the state of the global economy (Cole and Browne, 2015). At the same time, great advances in technology, economics, and ways of doing business are being observed, which are called the "fourth industrial revolution" (Blanco, 2011). This development provides great opportunities to reduce the negative impact on the environment and to solve other pressing global problems. Nonetheless, this revolution holds risks associated with changes in the structure of employment, deepening income inequalities and increasing cybersecurity (Lincaru et al., 2020).

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In particular, the uneven socio-economic development of the regions is one of the most relevant areas of economic policy development for most countries of the world (Pedrana, 2013). Their opinion is confirmed by the study of the World Economic Forum, which identified the most significant risks until 2020, including environmental issues and socio-economic development of the population (Primayesa et al., 2019).

3. Materials and Methods

According to a study by the World Economic Forum, which was conducted on the basis of the assessment of the Travel and Tourism Competitiveness Index (TTCI) in 2015 (Figure 1), changes were identified that will affect the development of tourism and business (Mikayilov et al., 2019).

Figure 1: The components of the formation of the competitiveness index in the field of travel and tourism
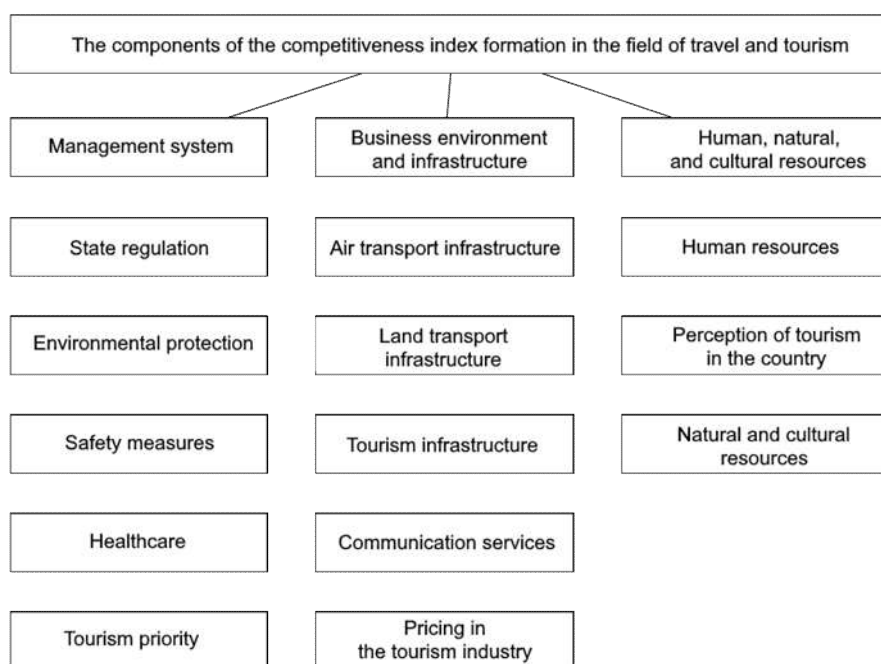
It should be noted that the study of the index allows to comprehensively study global processes in the economy, social and environmental fields, as well as to characterize the changes that directly affect the development of business, and tourism in particular. However, the matter of methods for evaluating the components of the competitiveness index in the field of travel and tourism remains debatable, because the indicators that characterize certain components of international ecological tourism are unclear (Baburin et al., 2018).

If we consider the modern experience of entrepreneurial activity in the process of tourism activity, we can say that it is necessary to develop ecological tourism more efficiently, that is, to reduce the level of permissible environmental impact to a value that can be called threshold. We believe that this will generally reduce the level of anthropogenic pressure that the territory experiences from private unregulated tourism in general. An important condition for this is a detailed and professional planning of the development of ecotourism, management, and monitoring of ecotourism.

4. Results and Discussion

To support environmental protection activities and search for alternative sources of financing, it is necessary to develop the structure of local ecological tourism. First of all, it is necessary to identify travel companies whose activities are most consistent with the principles of eco-tourism, and to promote their development both in the Arctic and on the international market of travel services, in order to attract inbound tourists to our country.

Equally important is the establishment of relations with leading foreign tourism companies, research centres, universities, etc. with subsequent participation in international

exhibitions, fairs, scientific conferences, and forums that are dedicated to environmental tourism. According to a study by the World Economic Forum, in 2019, climate deterioration is at the highest risk (due to the failure to implement the climate change program, which was adopted at the COP21 climate conference in Paris in 2015), as well as the level of population migration. A number of documents present five global risks projected by the World Economic Forum over the past decade (Hunter, 2002).

At the same time, it should be noted that the principles of eco-tourism provide not only that the local population receives income or new jobs as a result of an increase in the number of tourists, but the economic activity of the entrepreneur must meet the requirements of environmental sustainability, that is, not harm the environment, considering the needs of both current and future generations. Consequently, climate change is one of the most serious threats to society, the economy, and the environment. Changes in climate and weather patterns drive the demand for travel and tourist flows (Pleshanova and Yalyalieva, 2019). Due to the increase in temperature, the attractiveness of many destinations will disappear. Winter sports will become less practical in some places (Hunter, 2002). Coastal tourism is quite vulnerable to sea level rise. The changes that may take place soon are presented in Figure 2.

Figure 2: Territories that are under threat of different nature

Note: 1) WS – warmer summers; 2) WW – warmer winters; 3) SLR – sea level rise; 4) PD – political disorder; 5) LB – loss of land biodiversity; 6) MB – loss of biodiversity of marine animals and plants; 7) W – reduction of drinking water; 8) D – increased outbreaks of disease; 9) TCI – transportation costs increase; 10) EE – increase in the number of extreme events.

Global issues that affect tourism and business development should also include administrative barriers that impede the movement of people between countries. In this case, outdated practice of the visa issuance process and border control is seen. Nevertheless, this system is being improved: according to a UNWTO study, the share of global travellers who must apply for a visa has decreased from 77% in 2008 to 62% in 2014. Indeed, visa facilitation generates 89 billion US dollars in added revenue from international tourism and 2.6 million more country jobs in 2019. At the same time, there is now a global population migration in the world, therefore it is necessary to note the importance of border control to eliminate the possibility of a terrorist threat.

Secondly, the next step, which has an impact on the tourism sector, is the complication of the processes of hiring a professional. Studies show that for every 30 new tourists one job is created. It is believed that the field of aviation and tourism services is the largest employer in the world. In addition, this area has immense potential for further job creation. For example, according to forecasts of the World Economic Forum, by 2023, 338 million people will be employed in these areas. But currently there is a shortage of professional staff.

Thus, the public and private sectors need to work closely and update university curricula to meet the needs of the market and meet the technological advances of humanity. As noted, proceeding from the study, it is necessary to develop a curriculum in such a way as to satisfy the current and strategic needs of a particular circle of customers, social needs that require emphasis on the formation of existing competencies (Santos et al., 2017).

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A key factor is also the process of changing tourism demand. The tourism sector needs to thoroughly analyse the services that enterprises currently provide, because demographic indicators are changing, and the needs of tourists are changing with them. At the same time, modern tourists are paying increased attention to reducing the negative impact on the environment from an environmental standpoint. This happened due to the following processes currently being seen (Pessoa, 2013):
- forecasting an increase in the passenger flow of air transport by 31% until 2020;
- increase in electricity consumption by 20%;
- the rising number of tourists also increased the volume of waste, water use, and the deterioration of the state of cultural and world heritage objects.

Despite all the forecasts, world organizations are already trying to change the situation, namely: active negotiations are underway to establish standards and targets for measuring environmental impact. In addition, a major step is to increase the level of consciousness and responsibility of tourists (Maltseva et al., 2019). At the modern stage of human development, the most relevant is the issue of safety during travel. The progress that has been seen in tourism development in recent decades can stop and even change to regress through the following factors (Katircioglu et al., 2018):
- geopolitical tensions in the Middle East;
- growing threat of terrorism from the Islamic state;
- pandemic risk (an example is an Ebola virus outbreak);
- population migration due to several reasons.

Countries with political disorder are inevitably experiencing a decrease in the number of international tourists. No country has been able to protect its tourism sector from the consequences that have arisen due to the instability of the political system. Egypt's experience over the past decade is a good example. In 2005, in Sharm el-Sheikh and in 2006 in Dahab, terrorist acts were organized in which 23 Egyptians and tourists were killed. This situation caused a loss of 8% of foreign revenue from tourism. In 2011, following the resignation of President Mubarak, the Egyptian tourism market experienced a decline in annual tourism revenue from 14 million to 9.5 million US dollars. The story repeated two years later when political turbulence, which led to the overthrow of President Mursi, caused a decrease in tourist flow from 11.5 million trips in 2012 to 9.5 million in 2013.

Another example is Lebanon. The Lebanon-Israeli War of 2006, and a series of episodes of violence in 2008, according to the travel and tourism competitiveness report, led to a gradual decrease in tourism revenue by 17.3%. Examples can be found in other regions of our world. Thailand has seen a decline in tourist confidence since December 2008, when international airports started closing and many foreign travel agents left the country. This led to a 3% decrease in foreign tourist arrivals and a 12% decrease in foreign tourism revenues in 2009. The effect continued in 2010. Unfortunately, the current political situation caused a drop in about 18% of foreign tourist arrivals. All this leads to a decrease in the country's willingness to accept tourists, as well as a further decrease in its attractiveness for domestic tourists (Table 1).

Table 1. The average change in tourism costs of inbound and domestic tourists due to political disorder

Average expenses of inbound tourists, thousand dollars USA		
	2008	2009
Thailand	1,543	1,400
	2011	2012	2013
Egypt	983	967	927
Average expenses of domestic tourists, thousand dollars USA		
	2008	2009
Thailand	15,600	14,000
	2011	2012	2013
Syria	1700	1100	800

Given the above dynamics of changes in tourism costs of inbound tourists in different countries that have had political crises, we can conclude that each of these countries has suffered economic changes. Thus, the average expenses of foreign tourists in Thailand decreased by 9%. In Egypt, there is a situation where over two years the level of tourism costs

of inbound tourists decreased by only 6%. According to the travel and tourism competitiveness report, a vicious cycle is observed: political instability leads to lower demand and private investment is reduced (as investors lose confidence), public investment is reduced, tour operators and travel agents become less active due to insufficient orders or fear of tourists' security.

For example, German tourism giant TUI reported a loss of 46.4 million euros in the first quarter of 2012, mainly due to weak demand for travel to North Africa due to the Ebola virus outbreak, including a change in cruise lines in March 2014. Over the past decades, the scientific literature that covers trade processes and the factor of mobility, paid much attention to the issue of the correlation between migration and tourism. The connection between tourism and migration can occur in the following steps:

1)   firstly, this is a causal relationship between tourism and migration in matters of both obtaining jobs and consuming tourism services. This relationship is known as "tourism under the migration hypothesis";

2)   secondly, migration encourages relatives and friends to visit the country (VFR trips), thereby affecting the development of tourism in this country.

Thus, migration is one of the main prerequisites for VFR travel. However, more researchers in the world are starting to agree with the fact that the rate of increase in the number of forced migrants reaches a critical limit. The definition of this risk includes forced migration, which is caused not only by violence and conflict in countries such as Syria and Iraq, but also due to environmental or economic reasons. Global refugee flows have reached levels that are unprecedented in recent history. In 2014, 59.5 million people were forcibly displaced (compared to 40 million during the First World War). This problem is global in nature (Figure 3).

Figure 3: Map of macroregions with the most intensive migration flows in 2014-2015
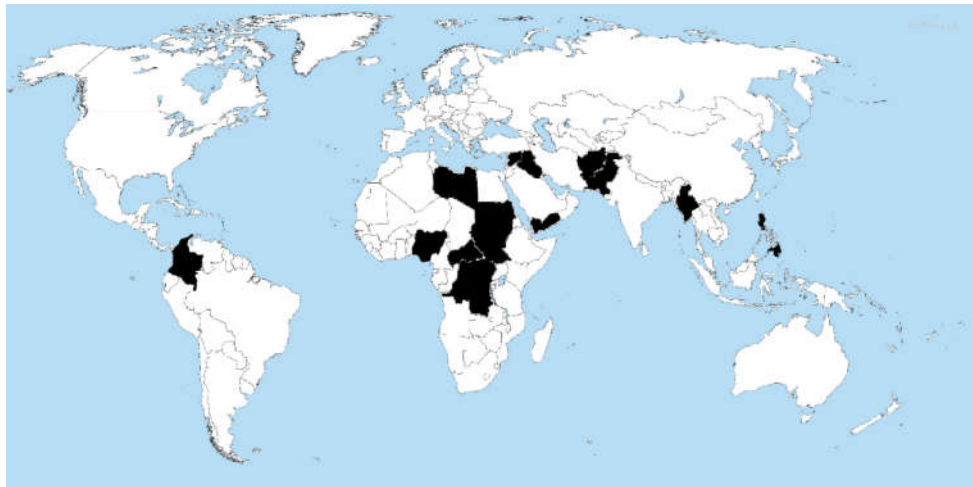
It follows that migration processes have a negative impact not only on the development of tourism, but also on the state of the economy and the social standard of living of the population. Furthermore, currently there is a tendency when people remain in the host countries more than they are used to (for example: in 1980 the average length of stay of a migrant in the country reached nine years, and in 2000 increased to 20 years). The longer people stay away from their home countries, the more difficult it is to return. This is because often they lose their money for life, family ties and physical properties, etc.

Lack of an effective integration policy in most countries can lead to the formation of ghettos or isolated communities on the margins of society, an increase in environmental pressure, and the emergence of social tension. In Europe, the rapid influx of migrants in 2015 challenged local financial and environmental resources, reinforced the trend towards polarization of society, which in turn undermined the effectiveness of European governance structures. All these factors, if unresolved, can pose risks in host countries. Although research on the economic impact of refugee influx is limited, it suggests that refugees can make a positive contribution to the host economy by increasing demand, remittance inflows, promoting the use of technology, and participating in international trade.

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Thus, summarizing the above risks, the issue of the process of reviving the intensity of tourist flows after periods of instability becomes relevant. One of the best ways to solve the abovementioned issues is to change the orientation from international tourism to domestic. A striking example of such changes is Thailand. In 2008, the government of this country started collaborating with the private sector to organize the Thailand Tourism Exhibition, according to which it was established that the tax rate was reduced for local airlines, hotels, and other tourism enterprises, thereby lowering prices and increasing the number of domestic tourists. However, revenues from domestic tourism are not always able to fully compensate for the losses incurred by enterprises because foreign tourists usually spend more money than domestic tourists. It should be noted that the development of eco-tourism will attract the attention of not only residents of the region neighbouring the Arctic, but also foreign tourists, due to the fact that they pay attention to environmental conservation, and also actively participate in eco-tourism trips. The development of ecological tourism in territorial-administrative units can provide an increase in real incomes for the rural population due to the following:

- provision of services for the reception of tourists;
- arrangement of tourist routes and the provision of excursion services;
- transport services for tourists;
- jaeger activities;
- provision of services for the rental of tourist equipment;
- production and sale of environmentally friendly products to tourists
- food, the provision of culinary services;
- sale of handicrafts;
- cultural and recreational activities factoring in the historical and ethnographic heritage (animation).

In addition, to reduce these risks and reduce the negative impact of various issues, it is important to make technological progress and introduce innovative processes that can increase both efficiency and traffic safety. There is a need to study ways to implement risk early warning systems, scenario planning, tourist data exchange. That is, it is necessary to improve the system of cooperation between international organizations, governments, and the private sector.

Thus, the global problems that have directly arisen already in the Arctic region, including national problems that play an important part in the course of travel planning, necessitated the development of not only the process of effective implementation and management of ecological tourism, but also the formalization of a system for assessing the development potential of eco-tourism.

Furthermore, as noted in the report "Socio-Economic Potential of Sustainable Development of the Arctic Region", one of the most important tools for long-term sustainable development of the Arctic region is the creation and development of medium and small business companies, providing them with simplified access to capital, and development of business related to tourism and the cultural heritage of the territorial-administrative units. With that, the environmental issues, contribution to the reduction of environmental risks, and the creation of new jobs in environmental professions do not go unnoticed. Thus, the matter of certification of ecotourism services as a part of the state evaluation of the potential of ecological tourism is still unsettled.

Currently there is a trend in the world in which ecological tourism, compared to mass tourism, is characterized by the most powerful and dynamic development. One of the main reasons for this dynamic is that environmental problems have become global, although they are manifested to varying degrees in various parts of the world. Extrapolation of the main provisions of the concept of sustainable development has its own logical, natural, scientific justification. This relates to the recognition of tourism as a multifunctional phenomenon of the 20th century (Figure 4):

- interdisciplinary subject area of knowledge;
- diversified field of human activity;
- sector of the global economy – the tourism industry, which is dynamically developing.

Figure 4: Functions of tourism and their target orientation

Tourism functions	Tourism Targeting

Economic	Production (employment promotion)
	Leveling the balance of payments
	Smoothing (revenue generation)

Social	Social and statutory
	Health-improving
	Humanistic

Culturological	Entertaining (educational)
	Integration (international)
	Educative
	Preservation of cultural and historical heritage

Ecological	Life safety
	Environment protection
	Resource saving

Recreational	Psychologically relaxational
	Intellectually relaxational
	Physiologically relaxational

According to UNWTO forecasts, ecotourism is one of the five main strategic directions of development for the period until 2020. According to expert estimates, the number of people concerned about the state of nature is growing. Environmental dysfunction creates the need for some people to change their attitude towards nature, for others – to actively participate in its protection and conservation, for still others – to renew natural resources. Some people, not limited to their own efforts, seek to attract supporters to their vigorous activity.

For example, 96% of CondéNastTraveler readers believe that hotels, motels, and resorts should handle environmental issues. Over 74.5% of respondents believe that the environmental policy of hotels affects their decision to stay there or not. Thus, the above suggests the seriousness of ecological tourism as part of the global tourism business and as part of the domestic tourism business. 55 billion US dollars' worth of goods and services are produced annually for ecological tourism, which makes up 25% of international trade in services and 12% of the gross world product. According to various sources, the annual growth in revenues from eco-tourism in the world amounts from 20% to 30% (Table 2).

Table 2. Forecasts of revenues from ecotourism in the world, billion dollars USA

1997	2000	2008	2014			
			Fact	Forecast		
				Pessimistic	Realistic	Optimistic
31.7	154	665	945	1,985.7	2,540.8	3,210
	2019			2020		
	Forecast			Forecast		
Pessimistic	Realistic	Optimistic	Pessimistic	Realistic	Optimistic	
4,117.5	6,203.1	9,168	5,929.2	9,692.3	15,493.9	

In 2019, there was a deviation from the predicted values of the rates of development of ecological tourism in the world. However, it should be noted that the increase in income from eco-tourism is growing not only due to increased demand. This increase is also conditioned upon population growth, income growth of its individual groups, reduction of working hours

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in many parts of the world, increase in vacation time, increase in the cultural and spiritual component, the increasing role of globalization of the world economy and social processes, etc. According to this, it can be argued that growth in demand for eco-tourism is determined by three main factors:

- general growth in tourism volumes;
- growing popularity of "travel for special interests";
- increasing public awareness and attention to environmental issues.

To date, analysis and evaluation of the demand of natural and ecological tourism are based on 60% of data for North America. The potential of the European continent, the Arctic region and the newly industrialized countries is still understudied. Currently, there are no fundamental studies of the global eco-tourism market. There are only a few marketing studies of individual tourist regions (for example, Kenya, Belize, Costa Rica, and of the latest – Germany, Finland, Namibia, Turkey). At the same time, existing studies focus on tours organized by tour operators and implemented as a single package of services, while the segment of individual tourism is not paid enough attention.

Promoting the social and environmental safety of tourism, especially in areas with a significant amount of natural resources, offers many opportunities for the country to become more competitive in the global market. The mainstream of ecotourism in the world is made up of residents of industrialized countries, interested in nature and life, preserved in the pristine corners of the planet. Of interest are the exotic nature and culture of Africa, Asia, Central America. The targeted policies of the host countries contribute to the formation of a large flow of ecotourists to Kenya, Tanzania, South Africa, China, Ecuador, Costa Rica, Thailand, as well as to New Zealand, Australia, and others. However, travellers interested in pristine nature of their own country or countries of their continent make up a large share of tourist flows.

Such trips are typical for Americans traveling in their own national parks, Europeans who choose the pristine territories of the Scandinavian countries for recreation. In the Dominican Republic, for example, tourists who spend the night in a bungalow spend 18 times less resources compared to passengers on cruise ships. In Costa Rica, according to experts, up to 53% of tourism income can be attributed to environmental tourism and environmental activities, as well as related services. Costa Rica is often seen as an example of how a country can develop strategically with the help of the correctly proposed eco-tourism policy.

Supporting protected areas that tourists visit so often can also bring long-term economic benefits to the national economy. Some countries were able to create a source of profit based on eco-tourism, to create foreign exchange earnings in the budget and provided employment for the local population. Positive forecasts of experts on the development of eco-tourism are noted in several European countries, such as Switzerland, Austria, Germany. According to experts, an increase in the volume of ecotourism trips will contribute to:

- the growing importance of daily environmental problems in leading tourist countries;
- an increase in the target ecotourism group at the expense of children brought up in an atmosphere of a conscious attitude to environmental protection;
- the growth of efforts that have been made to ensure tourism in the host countries.

The income of local enterprises received for the provision of services by environmental tourists is much higher than those that originate from mass tourism. Standard all-inclusive travel packages, as a rule, supply only 20% of revenues to local companies, and the remaining 80% of revenues come from airlines, hotels, and large tour operators. In contrast, ecological tourism allows saturating the budget of the local economy to 95%.

Africa is a market leader in ecotourism and accounts for about half of all environmental trips around the world: Botswana, Kenya, South Africa, and Tanzania. In the Great African Lakes region, tourism revenues based on gorilla and other animal species generate around 20 million US dollars a year. In Kenya, a ticketing system has been introduced to visit the Masai village. Instead of the guides who took the bulk of the income exploiting the locals, the Masai tribe themselves began arranging excursions. Currently, a fair share of income goes to residents. In general, revenue grew by 800%. The export of tourism services in Africa creates significant incentives for governments and local organizations to support their rich environment as the basis for sustainable tourism.

5. Conclusions

Thus, tourism is an excellent means of transferring income from developed countries to developing countries. Ecotourism is especially effective in this transfer. Therefore, it is necessary to determine the potential for the development of ecological tourism. A particular issue is the support of protected areas that can bring long-term economic benefits to the national economy. Some countries were able to create a source of profit based on eco-tourism, created foreign exchange earnings in the budget and supplied employment for the local population. The protected areas in Costa Rica, for example, have received over one million visitors each year for five years. Mexico has 14 million visitors a year, as well as over 25,000 jobs.

The opportunities and prospects of different continents and countries to develop ecological tourism on their territory significantly vary. It should be noted that the emergence and development of ecological tourism is closely related to the allocation of nature reserve funds, which are attractive from an aesthetic and recreational standpoint. It is the territories of the nature reserve fund that have become centres of ecological tourism around the world.

Studies by the IUCN Economic Service and the World Commission on Protected Areas (WCPA) have shown that in Canada, for example, annual GDP growth from conservation measures reaches 6.5 billion Canadian dollars. This allows to create 159 thousand jobs and provide tax revenues in the amount of 2.5 billion Canadian dollars.

In Japan, in turn, according to estimates by the Ministry of Agriculture and Forestry, forest ecosystems and agroecosystems provide public services worth 240 and 120 billion US dollars (12% and 6% of GDP, respectively). This played a significant part in the implementation of the national policy of conservation and preservation of lands occupied by natural biocenoses, and in the search for ways to generate income from them. In the case of the Arctic region, the nature reserve fund should become one of the main drivers of development.

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POPULATION ACCESSIBILITY TO RAIL SERVICES. INSIGHTS THROUGH THE LENS OF TERRITORIAL COHESION

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Abstract

Territorial cohesion is a concept that has played an important role in the European authorities' agenda since the 1990s, being linked to some of the main objectives defined in various EU Treaties (i.e. those envisaging flows, connectivity, spatial nodes, etc.). In this respect, the present research aims to explore territorial cohesion in relation to accessibility so as to provide a comprehensive picture of this subject, employing for the empirical study the Romanian railway system. The main objective is to examine how the Romanian railway infrastructure influences territorial cohesion through regions' accessibility to infrastructure and rail transport services. The research methodology consists of an exploratory study conducted using secondary data analysis. The collected data have been used to compute a set of indicators (the Engel ratio, the Goltz ratio, and the Hansen accessibility coefficient) that allows the analysis of the degree of population accessibility to railway transport, based on the characteristics of the rail transport service (distance, duration, and cost of travel). The study has revealed that the Romanian railway infrastructure does not have a positive contribution to reducing disparities and strengthening territorial cohesion. Although it is sufficiently extensive, it has uneven growth and low accessibility due to low travel speeds and long travel times. Regarding accessibility, the presence of at least two types of disparities – inter- and intra-regional, has been revealed, due to the fact that disparities in accessibility firstly manifest at the regional level and increase in intensity at the county level.

Keywords: territorial cohesion, population accessibility, railway network, inter- and intra-regional disparities, Romania

JEL classification: R1, R4, R42

1. Introduction

One of the most important goals of the European Union is to strengthen economic and social cohesion. It can be achieved by alleviating the social disparities and supporting solidarity with the disadvantaged social groups (vertical cohesion) and by decreasing regional disparities and strengthening the solidarity with the lagging regions' population (horizontal cohesion) (Constantin et al., 2010, Guastella & Timpano, 2010, Colak, 2015, Rastvortseva, 2017). As a result of this vision, the Treaty of Lisbon (2007) introduced a third dimension, namely territorial cohesion, which has become a basic pillar of the EU's regional policy.

As the EU harbors an incredible territorial diversity, territorial cohesion means that citizens should be able to make the most of the inherent features of the areas in which they live. No European citizen should be disadvantaged in terms of access to public services, housing, or employment opportunities simply by living in one region rather than another (European Commission, 2020).

Territorial cohesion is a concept that has played an important role in the European authorities' agenda since the 1990s. The term was popularized by Michel Barnier during his

term as European Commissioner for Regional Policy. Barnier made an explicit and detailed reference to the concept of territorial cohesion in the second European Union's report on the Member States' cohesion, which raised a complex debate about its meaning (Faludi, 2006, Constantin et al., 2013).

Also, territorial cohesion is a political concept that has been linked to some of the main objectives defined in various EU Treaties. In the second Cohesion Report (European Commission, 2001), the concept was associated with the objective of promoting a 'more balanced development' of the territory to achieve harmonious development of the European Union as a whole. The third Cohesion Report (European Commission, 2004) aimed to better clarify the concept, stating that „the concept of territorial cohesion extends beyond the notion of economic and social cohesion", further explaining that it helps „achieve a more balanced development by reducing existing disparities, avoiding territorial imbalances and by making both sectoral policies which have a spatial impact and regional policy more coherent. The concern is also to improve territorial integration and encourage cooperation between regions" (p. 27).

For this objective to be reached, an integrated approach is needed, based on better coordination between sectoral policies at each level, from local to European. It also entails closer cooperation and improved connections. Many issues - climate change, migration - do not respect standard boundaries and could be better addressed through a more tailored response from several regions or countries (European Commission, 2020).

The next step towards strengthening the territorial cohesion on the EU's political agenda was in 2009, when it was incorporated into the Treaty of Lisbon, together with the dimensions of social and economic cohesion. From this point on, territorial cohesion has become a fundamental concept, being also approached in the fifth and sixth EU cohesion reports (European Commission 2010, 2014). Further on, Territorial Agenda 2020 has stated that territorial cohesion is a common goal for achieving a more harmonious and balanced Europe, representing the EU's policy framework to support this vision. The Agenda provided strategic orientations for territorial development, ensuring that the territorial cohesion dimension is integrated into all policies at all governance levels. The Territorial Agenda 2020 defined six territorial priorities able to help at implementing successfully the Europe 2020 strategy. These priorities were: to promote polycentric and balanced territorial development, to encourage integrated development in cities and regions, to integrate the territorial dimension in cross☐border and transnational functional regions, to ensure the global competitiveness of the regions based on strong local economies, to improve territorial connectivity for individuals, communities, and enterprises, as well as to manage and connect ecological, landscape and cultural values of regions (Council of the European Union, 2011). The Territorial Agenda 2030 proposes two main objectives, namely: a Just Europe and a Green Europe, being revised in order to respond to COVID-19 pandemic impact, thus outlining territorial cohesion's important role in the recovery process. The new territorial perspectives are focused on balanced territorial development utilizing Europe's diversity, convergent local and regional development, less inequality between places, better living and working across national borders, and on a Green Europe that protects common livelihoods and shapes societal transition (Council of the European Union, 2020).

The transport infrastructure is considered an important factor with an impact on territorial cohesion, thanks to its function of uniting intra- and multi-national spaces. The transport systems, including railways, are essential features of all modern economies, considered to be a critical engine for regional, economic, and social development. Transport plays an important role in increasing production and employment, reducing travelling time, and improving accessibility. All these effects have an impact on achieving territorial cohesion and on reducing regional disparities (Alexiadis & Ladias, 2011, Hirobe, 2020).

Based on these overall considerations, the present research aims to explore territorial cohesion in relation to the concept of accessibility, in order to offer a relevant view on this topic, with the Romanian railway system as the observed entity of the empirical study. The main objective is to examine how and to what extent the Romanian railway infrastructure influences territorial cohesion through regions' accessibility to infrastructure and passenger rail transport services. The choice has been made considering Romania's strategic location on the EU map, as a 'turntable' for population and goods flows between the West and the South-

East. Thus, the state of territorial cohesion in Romania in terms of accesibility to rail services can be considered an important piece in the broader picture of the EU's territorial cohesion. Accordingly, the paper is organised as follows. After Introduction, the second section addresses territorial cohesion from the perspective of rail infrastructure accessibility, in both conceptual and practical terms. The third section proposes an inquiry into population accessibility to rail transportantion in Romania, which is explored at development region (NUTS2) and county (NUTS3) level as well, opening the door for a comprehensive view on territorial disparities: thus, both inter- and intra-regional levels are brought into discussion. In this respect, it is unanimously acknowledged that the deeper territorial granularity, the more realistic image of disparities. In line with this idea, the final part of the third section places the spotlight on the South-West Oltenia region, which plays a very important role in connecting the South of Romania (with Bucharest, the capital of Romania, included) to the West region, a major gate to the Western Europe. According to the territorial accessibility index proposed by Teclean and Dragan (2020) and calculated at NUTS2 level for all EU countries, the South-West Oltenia region belongs to „areas with average spatial accessibility", i.e. second quartile of this index from bottom-up (p. 34). The final section conveys the main conclusions, with an emphasis on the recommended policy measures aiming at reducing territorial disparities and strengthening territorial cohesion when the passenger rail transport accessibility is taken into consideration.

2.　Territorial Cohesion and Rail Infrastructure

The transport systems, including railways have a major contribution to reducing regional disparities and improving regions' competitiveness by facilitating trade and labour movement (Aldagheiri, 2010, Alexiadis et al. 2010).

Transport infrastructure leads to economic growth through several paths. Firstly, investments in infrastructure increase the demand for goods and services. Secondly, improving transport infrastructure reduces travel time with a direct impact on passengers and cargo carriers, which have fewer costs (Gunasekera et al., 2008). At the same time, the reduced travel time prompted by well-developed transport infrastructure can have economic consequences by supporting producers to access remote markets and obtain goods and therefore, stimulates local production. Thirdly, better infrastructure attracts foreign direct investments (Hong, 2007, Cechella, 2010, Sokolowicz, 2011, Khryseva et al. 2018), which have positive effects on economic growth. Finally, lower transport costs can accelerate industrial congestion and the concentration of economic activities (Hong et al., 2011).

Clear evidence of the transport infrastructure value and importance in the process of territorial cohesion is the European Union's interest in its development. Thus, the EU aims to transform transport policy into a policy of territorial integration so as the population from peripheral areas to have access to areas with a higher pace of development and to economic activities that would not normally be accessible in the transport infrastructure absence (Gallego et al., 2015).

2.1.　Significance and dimensions of Territorial Cohesion

The concept of territorial cohesion is associated with achieving a „more balanced development by reducing the existing disparities, avoiding territorial imbalances and developing both sectoral policy with spacial impact and regional policy as coherently as possible" objective (European Commission, 2004, p.27). Subsequently, the Green Paper on Territorial Cohesion (European Commission, 2008) identified three elements that should be taken into consideration in any analysis of territorial cohesion, namely: territorial concentration - overcoming density differences, connectivity - overcoming distances, and cooperation - overcoming division.

The term was often associated with regional differences without a critical reflection on its content and many studies approached it in a descriptive manner to analyze certain economic and social conditions in and between EU regions (Weckroth & Moisio, 2020, Anastasiou, 2020). In the 2000 - 2006 and 2007 - 2013 programming periods, the territorial cohesion concept was employed to refer to the level of regional disparities in economic production, using the GDP per head as the main indicator. Since the third Cohesion Report in 2004, the

term was strongly connected with achieving the objectives of the Lisbon Agenda: competitiveness, innovation, and employment (Mirwaldt et al., 2008, Zaucha & Szlachta, 2017). Territorial cohesion was about increasing the regional performance in the new member states to lower the regional disparities, which would have had a positive impact on the economic output of the whole EU territory (Weckroth & Moisio, 2020).

However, territorial cohesion can be also approached from an individual perspective, is defined as a spatial condition where people should not be disadvantaged wherever they happen to live or work in the European Union (Commission of the European Communities, 2004). This definition changes the approach of territorial cohesion from the macroeconomic disparities between regions' perspective and focuses on individuals and their life conditions, relating it with accessibility. This perspective relies on the concept of "accessibility of services of general economic interest" initially introduced by the Amsterdam Treaty (Commission of the European Communities, 1997) and bringing a new political-economic component to the territorial cohesion. Relating territorial cohesion with accessibility represents a qualitative shift from European regions' economic performance to their structural strengths and weaknesses. The approach of territorial cohesion from an individual perspective has been used during the last few years and particularly throughout the last programming period- 2014-2020 (Weckroth & Moisio, 2020).

The subject was mainly approached in studies where authors tried to identify the main components and dimensions of territorial cohesion rather than for a widely accepted definition. The literature review reveals the existence of very few studies that attempted to identify these dimensions, in order to provide theoretical support for the development of a methodology that could lead to an effective manner of measuring the territorial cohesion of a territory. In addition to EU's cohesion reports, studies on this subject area include several analytical tools, part of the European Territorial Observatory Network programme (ESPON). In these studies, the main elements of territorial cohesion are identified based on the territorial challenges faced by EU and the objectives stated in the cohesion reports.

Consequently, the elements defining territorial cohesion can be summarised as follows: balanced territorial growth; territorial connectivity; territorial cooperation; territorial polycentricity; access to services and infrastructure; environmental sustainability; socio-economic cohesion; economic competitiveness; territorial governance, social inclusion, and the quality of life (Medeiros, 2016).

Based on these elements and the cohesion objectives, the main dimensions of territorial cohesion have been proposed (Zamora et al., 2017):

a) The economic dimension: in a territorial analysis, the economic dimension generally refers to capital resources invested and mobilized to make a profit. This action is important and necessary in face of the steady increase in global competition (Gonzalez et al., 2015). Also, the economic dimension should be a key element in ensuring territorial cohesion, in particular by strengthening the economic competitiveness of a territory, increasing employment, promoting innovation, productivity, and entrepreneurship.

b) The social dimension: the relationship between the economic and social dimension is extremely important for achieving cohesion. It is necessary to integrate social components into economic initiatives as well as to integrate economic components into social initiatives. Generally, social cohesion represents the implementation of measures that will create equal opportunities for people to exercise their fundamental rights, will guarantee well-being, and will support anti-discrimination policies. In this particular case, this dimension addresses issues such as equality, education and culture, health, social inclusion and security, poverty, demographic structure, and access to basic services.

c) The environmental dimension of any process is becoming significantly more important, being an integrated part of the objective of achieving a more coherent, harmonious, and balanced territory. Through this dimension, the environment is considered the basis of life and a fundamental element for development. This is determined by the idea that future development depends on the national and international actors' ability to exploit natural resources sustainably. In this respect, actions such as improved and sustainable management of environmental resources, including water, soil, air quality, biodiversity, and landscape, are taken into consideration. It also addresses climate change issues, including flood risk and the need for a low-carbon economy (Gonzalez et al., 2015).

d) The institutional dimension: to achieve territorial cohesion, joint interaction, and institutional agreements between social actors is fundamental. Integrated spatial development requires new forms of horizontal and vertical cooperation with the purpose of strengthening networks and partnerships. The objective of territorial governance can be a sine qua non condition for ensuring a more balanced development, oriented towards achieving territorial cohesion. Thus, this dimension includes variables that reflect good governance, electoral participation, and the efficiency and cooperation of public institutions (Medeiros, 2016).

e) The integrated spatial development dimension: the spatial dimension is crucial in addressing the challenges faced by territories in the context of disparities and territorial imbalances. This dimension is based on the principles of balanced territorial development and alignment between communities and infrastructure and it attempts to act against monocentric trends and encourage polycentrism (González et al., 2015).

This dimension requires special attention because polycentricity has two complementary aspects: one related to morphology (communities, population density, distribution, etc.), and the other to relations between communities (connectivity, infrastructures, flows, networks, cooperation, transport, etc.) (ESPON, 2015).

Based on these dimensions, territorial cohesion is perceived as being the ability of territories to promote balanced development, to reduce existing disparities and territorial imbalances, and to promote processes of economic and social cohesion, as well as environmental sustainability through good territorial governance. It is important to identify these dimensions, not only because they make it easier to clarify the meaning of the concept, but also because they allow each dimension to be combined with the most suitable components and indicators for measuring territorial cohesion.

2.2. Rail infrastructure – accessibility issues in the context of Territorial Cohesion

Transport infrastructure occupies a fundamental place in the regional development process because of its impact on territory accessibility. Moreover, it is an important tool for territorial cohesion and integration, acting as a catalyst in the process of uniting several multinational spaces.

Accessibility is the main 'product' of a transport system that determines the local advantage of an area (region, city) to all areas, including itself. Accessibility indicators measure the benefits of households and businesses in an area, as well as the existence and usage of transport infrastructure relevant to the respective area. Good accessibility to transport is certainly an important factor in exploiting the territories' potential. Aspects such as capacity, travel speed, or infrastructure connectivity influence the quality and advantage of a location over other locations, being considered as factors of accessibility (Vulevic, 2016).

The role of transport infrastructure accessibility within territorial development implies that areas with better access to the locations of economic goods and entry markets will be more productive, more competitive, and therefore more developed than remote and isolated areas (Vulevic, 2016, Manaeva & Kanishteva, 2017, Kozhevnikov, 2020).

In this respect, a considerable number of debates regarding the effects of accessibility on economic development have been conducted as the spatial distribution of accessibility is one of the variables used to measure the regional disparities. Also, equal access to services of general economic interest (in this case, transport services) is an essential condition for territorial cohesion. For this reason, the EU pays special attention to the regions struggling with problems regarding accessibility and integration. Accessibility is thus a key factor in achieving the European Union's cohesion objective, namely ensuring a fair distribution of accessibility in all its regions and reducing the existing accessibility disparities (Lopez, 2005).

Some analysts believe that the regional development policies that focused on the transport infrastructure in the underdeveloped regions have failed to reduce regional disparities between EU regions, while others stress that this aspect must be still analysed.

Concerning policy-making, maximizing accessibility is only an objective as far as it contributes to improving the quality of life, the access to opportunities, goods, and services, and participation in social and cultural life (ESPON, 2015).

Over the years, a significant number of studies on the issue of accessibility of transport infrastructure have been conducted and the subject continues to be approached (Dionelis,

Mourmouris & Giaoutzi, 2012, Vulevic, 2016, Christodoulou & Christidis, 2019, Vulevic et al. 2020).

Yanovskyy and Matiychyk (2014) analysed accessibility to transport infrastructure, relating to the tangible characteristics of infrastructure, such as its length. This approach suggested that the level of infrastructural development directly affects the accessibility of passenger transport. Based on two accessibility ratios, namely Engel and Goltz, the author analysed the accessibility of the central region of Ukraine to two types of transport- road and rail.

Also, other authors (Karras, 2010, Briceño-Garmendia, Moroz & Rozenberg, 2015) focused on the relationship between the accessibility of transport infrastructure and economic prosperity. Their studies revealed that investments in transport infrastructure can have both positive impact (population or gross product growth) and negative impact (the economic degradation of the region, as businesses and residents can migrate easier).

More than that, investments in transport infrastructure positively influence the economic growth of an area if three conditions are met: the investment increases accessibility in a region, transport is relevant to the processes of firms within the area and infrastructure does not generate negative externalities on the environment. These conditions are supported in ESPON's report on the accessibility of transport in Europe (2011), namely that accessibility is important because it provides access to opportunities in remote locations or makes it possible to receive goods, services, and visitors from remote locations.

Thompson and Taniguchi (2001) concluded that the development of transport infrastructure (increased accessibility) leads to an increase in the number of jobs and a decrease in the prices of goods. Generally, high accessibility resulted from investments in transport infrastructure is considered an important benefit for users (citizens) and businesses. A traveler can make a journey at a lower cost or a higher convenience; congestion could be avoided and more than one destination could be reached at the same time. For companies, a reduction in transport costs can increase production efficiency, competitiveness, and attractiveness Also, better transport conditions can improve the labor market and productivity (Geurs, Patuelli & Dentinho, 2016).

Recent studies have focused on High-Speed Rail (HSR) and its impact on accessibility and development (Cascetta et. al., 2020, Monzon, Lopez & Ortega, 2019). In Europe, in 2016, the HSR was 8100 km planned and it continues to grow (Cascetta, 2019). The development of HSR is studied in countries around the globe, such as Australia, Belgium, China, India, Italy, France, Spain, Turkey, United Kingdom, USA, emphasizing its effect on socio-economic development and transport service (Cascetta et al., 2020). In another study (Jiao, et. Al., 2020) authors observed that HSR contributes to economic growth because it improves the accessibility and connectivity in the railway network. Also, they conclude that the benefit of HSR on economic growth is mainly accomplished by its network spillovers rather than the isolated existence of HSR infrastructure.

Other authors (Sakamoto, 2012, Rokicki & Stepniak, 2018) approached the subject of transport infrastructure investments and regional development related to accessibility. They noticed that accessibility improvement seems to be weakly but positively correlated with growth in regional employment, with an insignificant impact on the growth of regional production.

However, the relationship between accessibility and territorial and economic development is not simple or easy to infer, as the effects are extremely complex and difficult to predict. For example, improved accessibility between two countries, cities, areas or regions can sometimes benefit one of them but disadvantage the other.

Also, increasing equity, accessibility, and promoting economic efficiency are often conflicting objectives (Geurs, Dentinho, and Patuelli, 2016, Ben-Elia & Benenson, 2019). As an example, providing all individuals and relevant population groups with a basic level of access by providing public transport services in remote areas and/or providing public transport subsidies to specific population groups (elderly, disabled, etc.) is often economically inefficient.

More than that, accessibility is not easy to quantify and there is no generally valid approach. Accessibility measurements have been used in the scientific literature to assess the performance of transport networks. Measurement of accessibility also plays a key role in

evaluating the competitive advantage of some locations due to the quality of transport infrastructure.

Handy and Niemeier (1997) classified the existing measures into three categories: isochronous (indicating the number/proportion of destinations accessible in a given journey, time/distance/cost from an origin), gravity-based measures (which involve gradual decrease inaccessibility as travel time to destinations increases) and utility-based measures (which estimate accessibility at the individual level).

Another classification was established by Geurs and Ritsema van Eck (2001) which suggested four basic perspectives: infrastructure-based measures, activity-based measures, people-based measures, and utility-based measures.

The relationship between transport infrastructure and territorial development has become more complex than ever. The concept of accessibility ranges from very simple indicators to sophisticated indicators that may differ in complexity:

- Simple accessibility indicators – take into account only the transport infrastructure in the area (e.g. the length of the railways, the number of railway stations).
- More complex accessibility indicators – take into consideration the connectivity of transport networks and distinguish between the network itself and the opportunities that can be accessed using transport infrastructure.

More complex accessibility indicators can be classified by destination and impedance factors (Schürmann et al., 1997):

- Cost indicators measure the total travel cost for a set of predefined destinations.
- Daily accessibility is based on the notion of a fixed timeframe that a person is willing to dedicate towards fulfilling a journey. Maximum travel times between three and five hours are frequently used for this type of indicator.
- Potential accessibility is based on the assumption that the attraction of a destination increases with size and decreases with distance, travel time, or cost. The size of the destination is usually represented by population or economic indicators, such as GDP or incomes.

Based on the three basic accessibility indicators, an almost unlimited variety of derived indicators can be developed.

3. An Inquiry into the Population Accessibility to Rail Transportation in Romania

3.1. Data and research methodology

The present research aims to examine Romanian railway infrastructure's influence on territorial cohesion through regions' accessibility to infrastructure and passenger rail transport services. As mentioned in the Introduction, Romania represents a relevant case study in this respect, given her strategic location on the EU map: she can be seen as a 'turntable' for passengers and goods flows between the West and the South-Est and thus the state of territorial cohesion in Romanian from the accessibility viewpoint can offer significant hints about the accomplishment of the overall European targets for this chapter.

Based on this purpose, the study's main objectives are:

O1: To identify regions' degree of accessibility to railway infrastructure in Romania using Engel and Goltz ratios.

O2: To identify the degree of accessibility to the existing railway infrastructure in the South-West Oltenia region using the Hansen accessibility coefficient, as well as the accessibility of Craiova city to other important economic centers from Romania. The choice of this region was based on its role for ensuring the connection of the South part of Romania (where Bucharest, the capital city is located) to the West region, a major gate to Westren Europe.

O3: To propose recommendations on improving accessibility to infrastructure and passenger rail transport services.

The research methodology consists of an exploratory study conducted using qualitative and quantitative approaches.

In accordance with the study's objectives, the calculation of the following indicators has been envisaged:

1.   The Engel ratio: shows the rail transport network accessibility related to the population of a given area, the accessibility being computed according to the existing kilometers of railway within an area/region:

$$E = \frac{L}{\sqrt{S * P}}$$

(1)

where:
L= the railway network length (km)
S= the total surface of the area/ region (km^2)
P= the population of the area/ region

2.   The Goltz ratio: shows the accessibility of the transport network, related to all existing communities within an area:

$$R = \frac{L}{\sqrt{S * N}}$$

(2)

where,
L= the length of the railway network (km)
S= the total surface of the area/ region (km^2)
P= the total number of the communities within the area/ region

3.   The Hansen accessibility coefficient allows analyzing the degree of accessibility to railway transport, based on the characteristics of the rail transport service (distance, duration, cost of travel).

The Hansen index is the mathematical expression of the accessibility of a point of interest "j" relative to all points of origin "i" in a given space "S":

$$A_j = \sum_{i \in S} \frac{1}{f(x_{ij})}$$

(3)

where:
- $f(x_{ij})$ is the impedance function (the function of the difficulties encountered during a journey);
- x_{ij} is the variable of the impedance function, that can be expressed through:
- the distance traveled between the origin point "i" and the destination point "j"
- the travel time between the origin point "i" and the destination point "j"
- the cost of travel between the origin point "i" and the destination point "j"

These indicators proved their relevance in previous studies undertaken at international level (e.g. Yanovskyy & Matiychyk, 2014) given their composition, the application in the case of Romania is feasible as well. The necessary input data are annually provided by the National Institute of Statistics of Romania. In addition, data provided by CFR Travellers website (the website of the Romanian Railways – Passenger Section) have been used.

3.2. Results

The Romanian railway network is structured in interoperable and non-interoperable infrastructure. The interoperable railway infrastructure connects to the trans-European rail infrastructure, being managed in accordance with the provisions on open access for railway operators and developed following the technical rules for interoperability adopted at the European level. Non-interoperable rail infrastructure represents the local traffic-related infrastructure, whether or not connected to interoperable rail infrastructure, managed and developed based on specific internal regulations (CFR, 2020).

Image 1: The Romanian railway network map
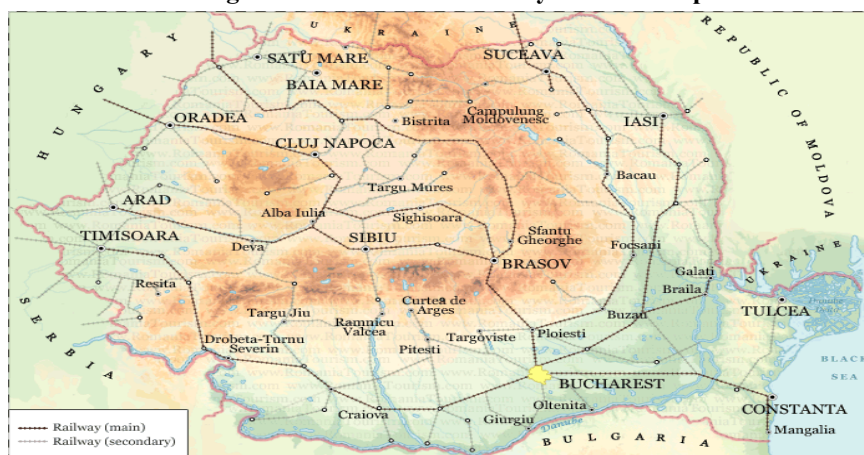
Source: Romania Tourism, 2020

Table 1: The railway network length in the Romanian regions (2019)

Regions	Population	GDP/capita	Railway(km)
NORTH-WEST	2552112	44853,5	1663
CENTER	2318272	46658,7	1333
NORTH-EAST	3198564	30762,6	1614
SOUTH-EAST	2396171	40568,3	1745
SOUTH-MUNTENIA	2929832	38050,1	1247
BUCHAREST-ILFOV	2315173	111159,5	279
SOUTH-WEST OLTENIA	1926860	50144,4	990

Source: Authors, adapted by the National Institute of Statistics, 2020

The railway network in Romania (Image 1) has a total length of 20,077 km of lines, making it the seventh-largest network in the European Union. The lines are connected by 20,070 equivalent switches. The network comprises 17,945 bridges and bridges, 176 tunnels, and 11,473 km earthworks (CFR, 2020). South-East region has the highest railway density (1745 km), followed by the North-West region (1663 km) and Bucharest-Ilfov, the lowest (279 km).

3.2.1. Accessibility at development region and county level

This section presents the results regarding the analysis of the population's accessibility to the rail transport infrastructure through several reports and accessibility indices.

To investigate the degree of accessibility at the regional level, the Engel ratio, which shows the accessibility of the rail transport network related to the population of a given area, and the Goltz ratio, which shows the accessibility of the transport network in relation to all existing communities within an area, have been used. In both reports' cases, the accessibility is computed based on the existing rail network (kilometers) within an area/region. Both the NUTS2 (development regions) and NUTS3 (counties) levels have been considered. The territorial structure of Romania for these levels is presented in Image 2.

Image 2: The territorial structure in Romania – NUTS2 and NUTS3

COUNTIES GROUPING, BY DEVELOPMENT REGION
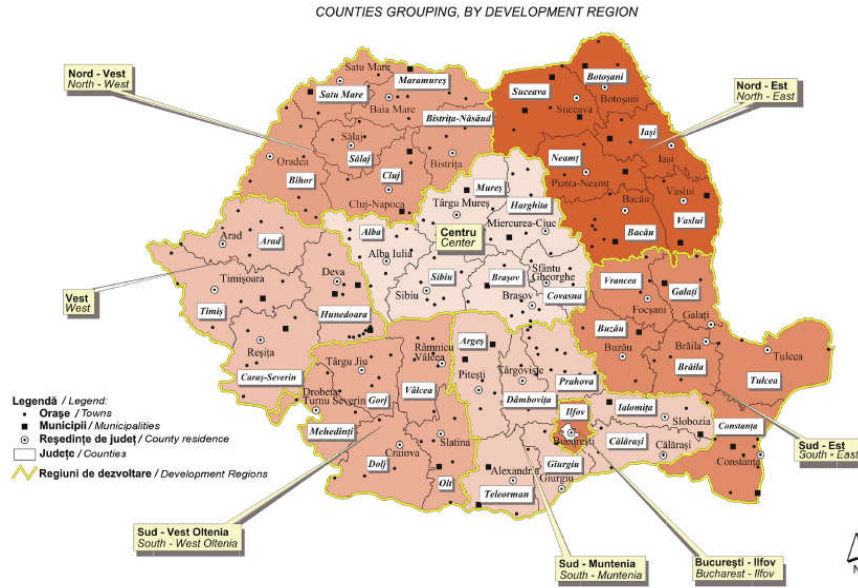
Source: National Institute of Statistics

Figure 1: The accessibility of North-East Region
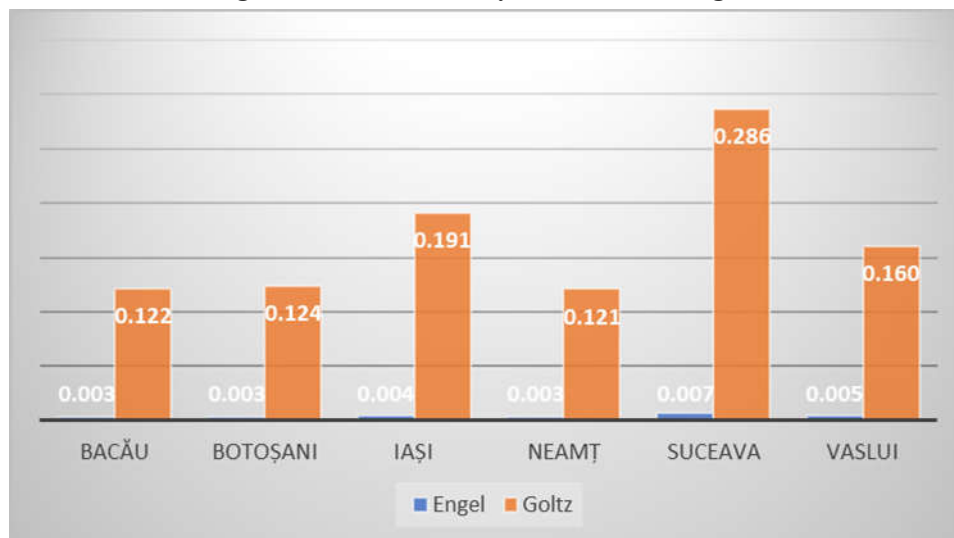
Source: Authors, based on the results of Engel and Goltz reports

Within the North-East region, the county with the highest degree of accessibility is Suceava, which registered the highest values for both reports. In this county, the railway infrastructure is more developed compared to the rest of the counties, Suceava having a total of 526 km of the railway network. Also, Iasi County registered high values in terms of Engel ratio, but lower values than Vaslui County. The result is explained by the fact that, although both counties have almost the same area, the infrastructure of Iasi County serves a population twice that of Vaslui County.

Figure 2: The accessibility of South East Region
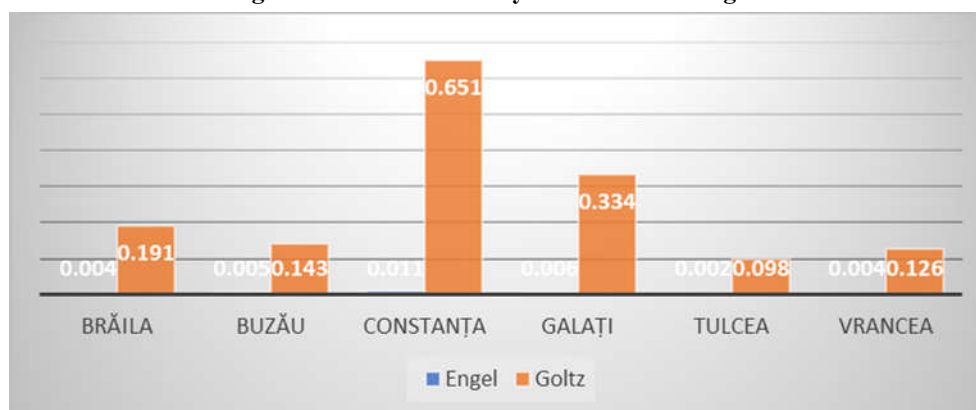
Source: Authors, based on the results of Engel and Goltz ratios

Concerning the South-East region, the county with the greatest accessibility is Constanța, which posses a more developed railway infrastructure compared to the rest of the counties, which is also due to the presence of the port of Constanța. High accessibility of the population to the transport infrastructure was also revealed in the case of Galați County, followed by Brăila, Buzău, and Vrancea. The lowest accessibility, compared to the rest of the counties in the region was registered in Tulcea, the county where the Danube Delta is located.

Figure 3: The accessibility of South-Muntenia Region
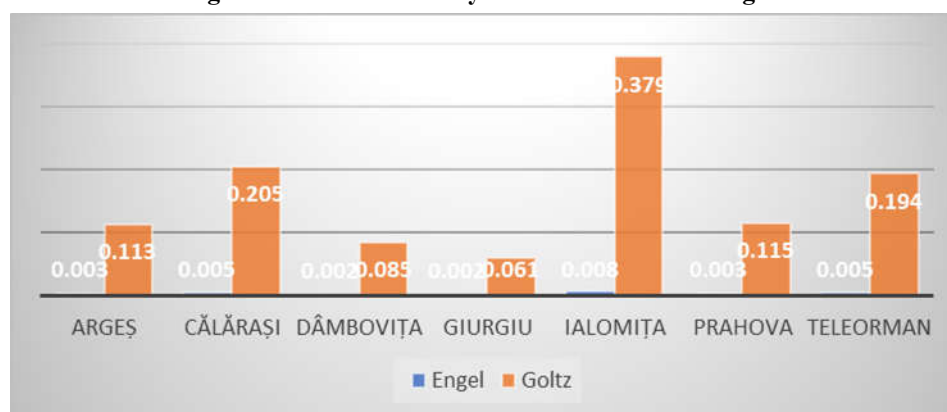
Source: Authors, based on the results of Engel and Goltz ratios

In the South-Muntenia region case, the county with the highest accessibility of both the population and the communities to the railway infrastructure is the Ialomița. Another county with high accessibility of the population to the railway infrastructure is Călărași which is followed by Teleorman, Prahova, Dâmbovița, and Giurgiu. This order remains in the Goltz ratio's too, indicating the accessibility of all existing communities within a region to the infrastructure that serves the analysed region.

Figure 4: The accessibility of South-West Oltenia Region
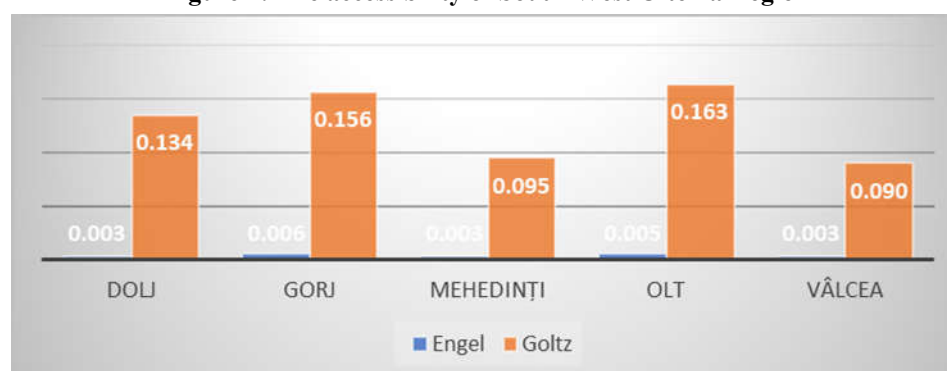
Source: Authors, based on the results of Engel and Goltz ratios

Concerning the South-West Oltenia region, the counties with a high degree of accessibility are Olt and Gorj, which recorded the highest values. The difference between them is that, while the Olt has higher accessibility of communities to the railway infrastructure, Gorj register higher accessibility of the population. The rest of the counties presented similar values for the Engel ratio, but there are differences regarding communities' accessibility.

Figure 5: The accessibility of West Region
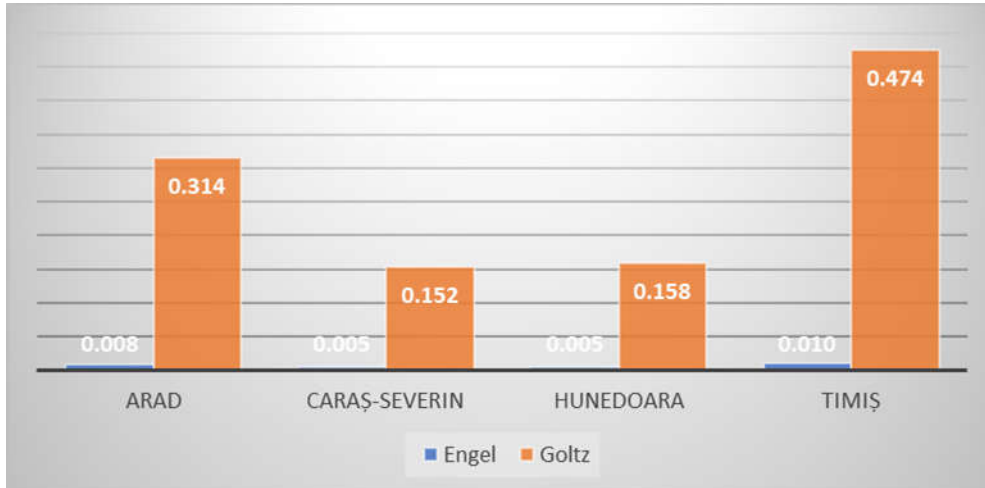
Source: Authors, based on the results of Engel and Goltz ratios

In the West region's case, the greatest accessibility to transport infrastructure was observed in the case of Timiş County, for the population as well as for communities. High values were also registered in Arad County for the two reports, followed by Hunedoara and Caraş-Severin, both areas presenting similar values.

Figure 6: The accessibility of North-West Region
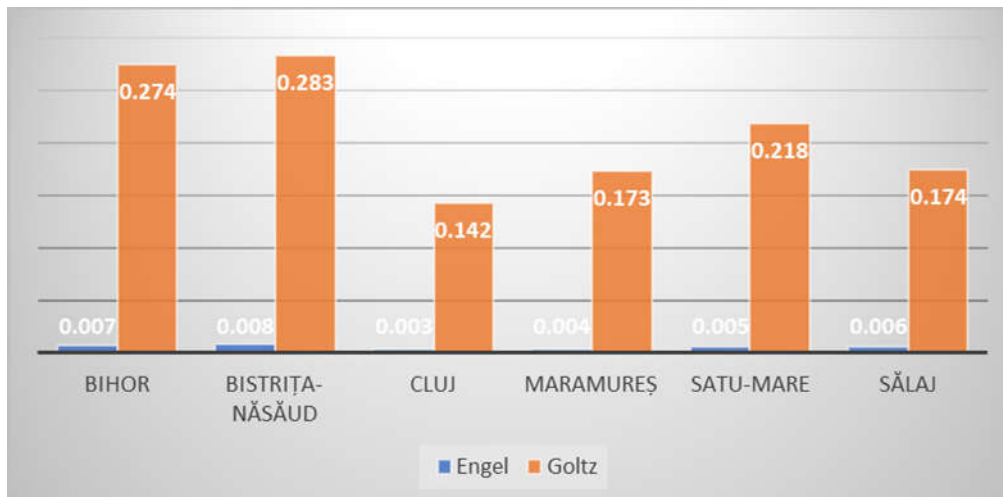
Source: Authors, based on the results of Engel and Goltz ratios

In the case of the North-West region, the counties with the highest accessibility of the population to the transport infrastructure were Bistriţa-Năsăud and Bihor, which also presented the highest degree of accessibility for communities. Satu-Mare county also registered high accessibility for communities, but according to the outcome of the Engel ratio, it registered lower accessibility of the population compared to Sălaj County. Overall, the differences in accessibility are quite significant.

Figure 7: The accessibility of Center Region
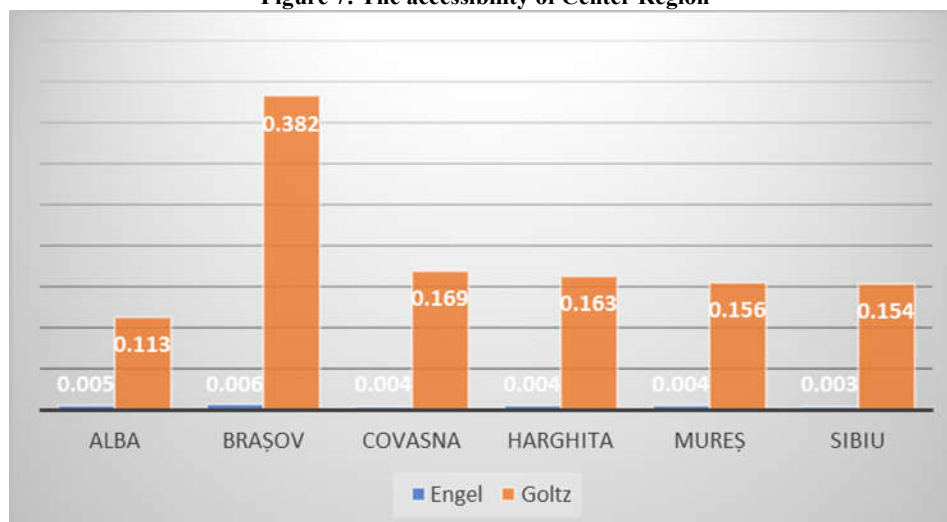
Source: Authors, based on the results of Engel and Goltz ratios

In the Center region's case, the highest degree of accessibility from both population and communities was registered in Braşov county. Covasna, Harghita, and Mureş counties registered similar population accessibility and minor differences regarding communities' accessibility. Although Alba County presented the lowest accessibility of communities, in its case a higher level of accessibility of the population was observed, compared to the aforementioned counties.

Figure 8: Romanian regions' accessibility
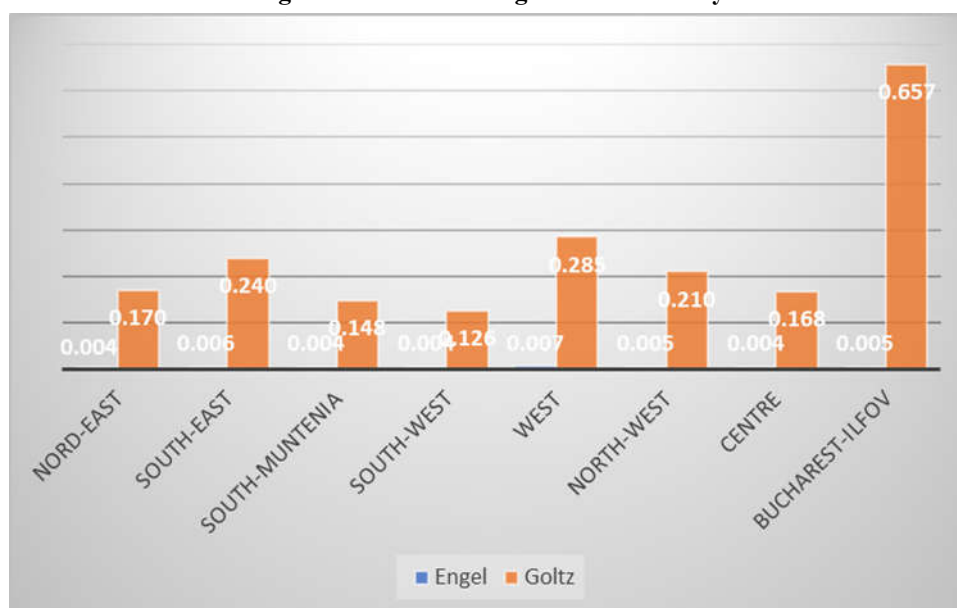
Source: Authors, based on the results of Engel and Goltz ratios

Overall, the region with the highest degree of accessibility is the West region, without considering Bucharest-Ilfov. In this analysis, the Bucharest-Ilfov region was not analysed because it represents a special case related to its small surface and a very high number of citizens compared to the rest of the regions. At the same time, given Bucharest's status of capital city, it is by far the most important railway node in the country.

As regards the situation of accessibility to transport infrastructure, it can be affirmed that there are differences both at regions' level and in their administrative components (counties), the intensity of these differences varying from case to case. In most cases, greater accessibility was registered in the counties which represent important economic centers or transport hubs.

3.2.2. Spotlight on South-West Oltenia development region

Within this section, using the Hansen accessibility index, the degree of accessibility within the South-West Oltenia region will be analysed to identify the accessibility of the main cities of the county towards Craiova economic center based on the traveled distance, the costs, and the necessary time of a train journey. The processed data were gathered from the CFR Travellers website (Romanian national railway company). There have been taken into consideration especially the direct trains, and in the cases where there were no direct trains, the trains involving several exchanges have been taken into account. Regarding the significance of the Hansen report, the high results showed high accessibility of the chosen city compared to Craiova.

Figure 9: South-West Oltenia cities' accessibility
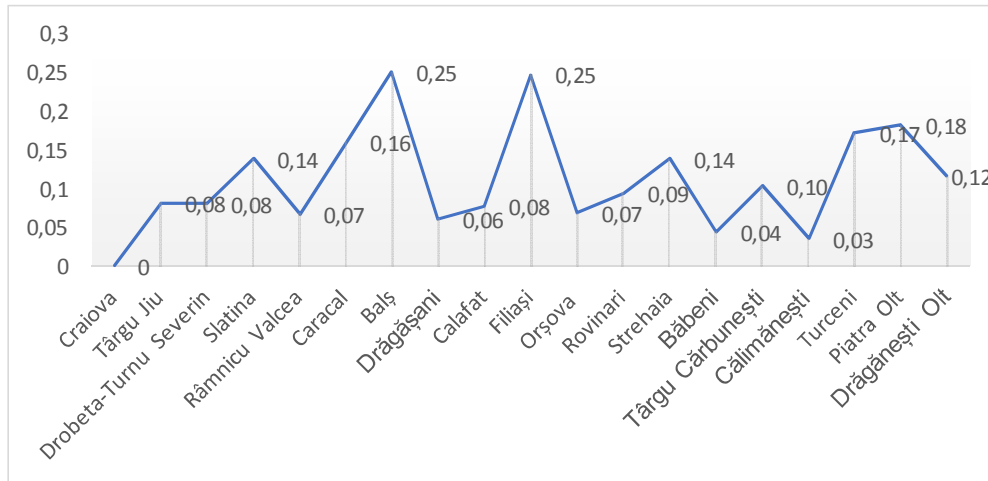
Source: Authors, based on Hansen index

The analysis results reveal that the towns and cities from South-West Oltenia region can be grouped into 3 categories: cities with high accessibility, such as Balş and Filiaşi, cities with average accessibility, such as Slatina, Caracal, Strehaia, Targu Carbunesti, Turceni, Piatra Olt and Drăganesti-Olt and cities with low accessibility, such as Târgu Jiu, Drobeta-Turnu Severin, Râmnicu Vâlcea, Drăgăşani, Calafat, Orşova, Rovinari, Băbeni and Călimăneşti.

Considering these results, it can be stated that the variable with the highest influence within the Hansen index is the distance. An indirectly proportional relationship between the traveled distance and the degree of accessibility was observed: if the distance to be traveled increases, the degree of accessibility decreases. At the same time, long-distance also results in a higher period of time necessary for traveling.

More than that, one can affirm that the accessibility of these towns and cities follows one of the trends described by Handy and Niemeier (1997), namely that the accessibility decreases as the distance increases. This relationship determines the presence of a center-periphery pattern because the cities near Craiova (Balş and Filiaşi) present higher accessibility, the degree of accessibility diminishing the further away we moved from the chosen economic centers.

Using the Hansen index, the accessibility of Craiova compared to other economic centers from Romania by rail transport was analysed. As in the previous part of the analysis, the processed data was gathered from the CFR Travellers website, taking into account, in particular, direct trains. In the absence of these, trains involving several shifts have also been selected.

Figure 10: The accessibility of Craiova city
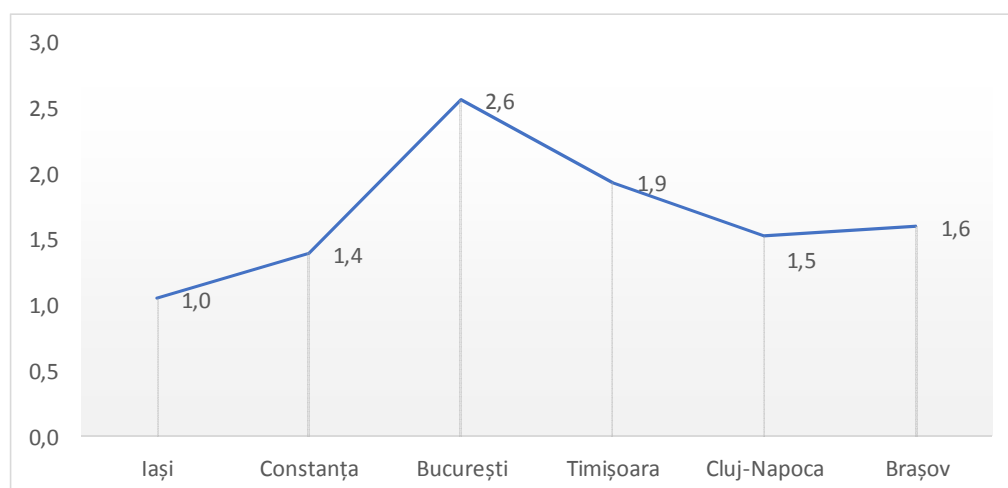
Source: Authors, based on Hansen index

The results reveal that, concerning rail transport, the accessibility of Craiova compared to other economic centers differs depending on the city chosen as the destination. Thus, Craiova has high accessibility compared to Bucharest and Timisoara and average accessibility compared to Constanta, Cluj Napoca, and Brașov. Regarding Craiova's accessibility to the city of Iasi, the lowest value is recorded because the analysed variables registered the highest values compared to the rest of the cities. Also, in this case, a similar pattern similar to the one described above was observed: the long distance to travel leads to a longer journey time, consequently, the accessibility lowers. Another influencing factor is the frequency of direct trains, more trains running on the Craiova-Bucharest route.

4.   Concluding remarks and recommendations

The rail transport infrastructure is a basic element within a territory, influencing economic growth and reducing regional disparities by improving regions' competitiveness. In this respect, the present research explored the manner in which the Romanian railway infrastructure influences territorial cohesion through regions' accessibility to infrastructure and passenger rail transport services.

In order to achieve an overview regarding the accessibility of Romanian regions to transport infrastructure, the Engel and Goltz ratios were used for computing the accessibility to the infrastructure according to its length and the covered area, population, and the total number of communities within a region. The results revealed the presence of differences in accessibility at both the regional and county level.

The analysed data showed that, without considering Bucharest-Ilfov region, the West region presents the highest degree of accessibility.

Further on, lowering the observation scale, by analysing the accessibility of a region's cities related to its main economic center, it can be noticed that these cities' accessibility presents a center-periphery pattern: with the increase of the distance between the chosen city and the economic center, the accessibility decreases.

In view of the results outlined above, it cannot be affirmed that the Romanian railway infrastructure contributes to reducing disparities and strengthening territorial cohesion. Although it is sufficiently extensive, it has uneven growth and low accessibility due to low travel speeds and long travel times. Regarding accessibility, it should be mentioned the presence of at least two types of disparities - interregional and intra-regional, due to the fact that disparities in accessibility firstly manifest at the regional level and increase in intensity at the county level.

The potential of the Romanian railway infrastructure is extremely high and, as a consequence, in order to have a positive impact on reducing disparities and strengthening territorial cohesion several policy actions are necessary, the ones recommended below included:

1.   Better usage of the European funding allocated for railway infrastructure.

The railway infrastructure in Romania requires the allocation of higher amounts of funds to increase its competitiveness, amounts that cannot be fully supported by the state's budget. Future investments should focus exclusively on the rehabilitation and modernization of railways and the existing rolling stock in operation, to allow for high travel speeds and a higher degree of comfort.

      2.   Joint partnerships between railway managers and local actors or administrative authorities. In most cases, the accessibility of the population to the railway transport infrastructure is influenced not only by factors related to it and its degree of development but also by aspects related to the level of development of the area from which users come.

For example, in some communities' case, there is no means of transport to provide the population with access to railway stations. In addition, higher accessibility cannot be achieved only by developing railways no matter how many resources are invested in them. It is, therefore, necessary to rehabilitate the access routes to the railway stations, as well as to rehabilitate these stations, but this cannot be done without the involvement of the local authorities.

      3.   Adapting transport schedules according to user needs and requirements. Reaching a higher degree of accessibility and attractiveness for rail transport can also be obtained by changing existing transport schedules. In order to be able to identify these needs or requirements, questionnaires could be distributed to passengers when boarding the trains.

      4.   Attracting and training human resources. One major problem that will be increasingly wide is the lack of railway staff such as mechanics and aid mechanics. The lack of attractiveness of the railway sector, the low level of development of infrastructure and rolling stock, as well as existing working conditions are the main factors determining the decreasing number of young people choosing a career in this field.

      5.   Increasing the presence of private operators and supporting a healthy competitive environment. The presence of private operators on as many routes as possible could lead to increased accessibility as well as increased efficiency and quality.

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ANALYSIS OF URBAN CONNECTIVITY EFFECTS OF THE SOUTHERN FEDERAL DISTRICT[1]

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Abstract

Today, existing urban imbalances in Russia distort the territorial space, demonstrate its insufficient integrity, which leads to high differences in the quality of life of citizens and social instability. In order to make effective and scientifically sound management decisions, it is necessary to understand the mechanisms underlying the functioning of cities, which actualizes the study of the effects of their connectivity in territorial space.

The aim of the study is to develop an approach that allows us to determine the effects of urban connectivity in territorial space. The estimation method is based on the calculation of global and local Moran indices to determine the effects of the connectivity of territories by indicators: "population size", "migration growth", "volume of shipped products per capita". The information base was the data of the Federal State Statistics Service, the calculation of distances was carried out according to the data of the automobile portal. The object of the study is the cities of the Southern Federal District, with a population of more than 100 thousand people in 2017. The calculations made it possible to determine the type (direct and reverse) and the strength of inter-territorial relations according to the parameters under consideration: according to the indicator "population size" there is a negative autocorrelation, according to the indicator "migration growth" and "volume of shipped products per capita" - positive autocorrelation. According to the indicator of the volume of shipped products per capita, polarization was revealed: Volgograd and Volzhsky are disconnected from the rest of the group of cities, while they do not have a significant impact on nearby territories. The strongest direct inter-territorial links are identified in the group of leading cities relative to each other. The indicator of «migration growth» observes significant inverse effects, largely Maykop falls into the zone of influence of leading cities.

The practical importance lies in the possibility of using the results obtained by regional authorities in developing a strategy for the development of cities and regions in terms of identifying the production clusters of the region.

Keywords: Moran index, spatial autocorrelation, inter-territorial connection, city
JEL classification: R12

1. Introduction

The current differences in the socio-economic development of the cities and regions of the Russian Federation have a significant impact on the state structure, the structure and efficiency of the economy, and the strategy and tactics of institutional changes. The management of the spatial development of cities is becoming more important in the Russian Federation, which is determined primarily by the high inter-territorial differentiation according to a number of key indicators. Population, investment, services are unevenly distributed in the territory of the Russian Federation: there is a significant concentration in the central part of the country (Moscow, Moscow region, Saint Petersburg) and the effect of dispersal from the center to the East.

Existing urban disparities distort spatial space and demonstrate its lack of integrity, which leads to high disparities in the quality of life of urban dwellers and social instability. Effective and scientifically based management decisions require an understanding of the mechanisms,

conditions and factors underlying the functioning of cities, which updates the study of their connectivity effects in the territorial area of regions and in the country as a whole.

The aim of the study is to develop an approach for determining the effects of urban connectivity in the territorial area.

2. **Literature review of the study**

To conduct this study, a detailed analysis of the literature was carried out in two directions: the spatial development of cities and the theory of spatial autocorrelation.

In foreign scientific literature at the end of the 20th century, the urban agglomeration economy, singled out, as a field of knowledge from the new economic geography, became a popular direction. Economists try to explain the role of city size (population) in economic efficiency and to assess the interaction of cities. The underlying principle of the theoretical models is that, in industrialized countries, not only a large part of the population but also economic activity is concentrated in cities, and urban structure is the result of the dynamic interaction of economic activity and urban growth [Gabaix, 1999; Duranton, 2007; Corboda, 2008].

Particularly popular is the urban growth theory presented in the works of K. Gabaix [Gabaix, 1999], J. Eeckhout (2004) [Eeckhout. 2004], M. Partridge, D. Rickman, C. Ali, M. Olfert [Partridge et al, 2008], K. Schlüter, A. Lalanne, M. Zumpe [Schlüter et al, 2015]. Urban growth models are based on a balance of advantages, the costs of agglomeration, economic forces such as employment, transport costs, market potentials and technological innovation. A number of models offer similar deterministic factors that are fundamental to explaining the complex dynamics of urban hierarchies.

The problem of the location and development of cities in the spatial economy is gaining in importance in the work of Russian scientists at the beginning of the 21st century. A.I. Trejvish assessed the dynamics of the rank of Russian cities from 1967 to 2002 and concluded that in a significant part they (ranks) remain. This conclusion confirms the stability of the urban system of the Russian Federation [Trejvish, 2009]. A. M. Arhipov developed a functional typology of cities with the allocation of features: the degree of development of the functional structure, territorial content of functions, economic and geographical location [Arhipov, 2010]. Andreev evaluates the location of cities in the Volga Federal district using the Zipf law [Andreev, 2017]. E. A. Kolomak presented empirical patterns of development of the Russian urban system, analyzed the level of urbanization, and offered econometric estimates of factors of development of the urban system [Kolomak, 2018].

Spatial autocorrelation theory has been a key element of geographical analysis for more than twenty years. The availability of large data sets with spatial reference and complex visualization capabilities have created a need for new methods of spatial data analysis, both research and confirmatory [Anselin, 1992; Openshaw, 1993]. Spatial structural instability or spatial drift has been included in a number of modeling approaches. Discrete spatial modes are taken into account in the analysis of variance [Griffith, 1978; Griffith, 1992; Sokal et. al., 1993] and in regression models with spatial structural changes [Anselin, 1988; Anselin, 1990]. A number of spatial correlation measurements are proposed to study the spatial process of geographical evolution from different points of view [Bivand, 2009; Haining, 2009; Li et. al., 2007; Tiefelsdorf, 2002; Weeks et. al., 2004]. The most popular tool for measuring correlation is the Moran index [Moran, 1948], which is a generalization of the Pearson correlation coefficient. Concepts and methods of spatial autocorrelation have been applied to many areas, resulting in a number of interesting results. Chen reconstructed the matrix of spatial weights and the Moran index and, improving the scattering graph, presented four approaches to calculating the Moran index, which contributed to the development of the analytical process of spatial autocorrelation [Chen, 2005]. Yu. V. Pavlov and E. N. Koroleva apply the local and global Moran index to identify clusters and subclusters. Scientists have identified four territorial clusters and six subclusters in the Samara region [Pavlov, Koroleva, 2014]. V. A. Rusanovskij and V. A. Markov use the Moran index to measure the spatial localization of unemployment. This index gives correct results for complex systems when relations between neighboring territories are linear [Rusanovskij, Markov, 2016] A.V. Suvorova using the Moran index developed an approach for identifying direct and inverse

effects of the development of growth poles, and measured the scale of their influence on the territories centered around [Suvorova, 2019].

3. Research methodology

When analysing the spatial characteristics of cities, priority is given to the characteristics of their population, the proximity of the objects, the scale of the systems and their concentration within the territory. Spatial econometric techniques - the calculation of global and local Moran indices - are useful for determining the effects of urban connectivity, which will make it possible to determine the degree of coherence of the parameters characterizing the development of neighboring cities.

The methodology for assessing urban connectivity using the Moran index consists of the following steps:

1) Collection of statistical data, construction of a matrix containing information on the distances between all territorial units studied (in this study - cities within the boundaries of the Southern Federal District). The distance matrix will be based on information on the length of roads between cities of the Federal District.

2) Calculation of the global Moran index by the formula:

$$I_G = \frac{N}{\sum_i \sum_j w_{ij}} * \frac{\sum_i \sum_j wij(x_i - \mu)\ (x_j - \mu)}{\sum_i (x_i - \mu)^2} \tag{1}$$

Where I_G is the Moran Global Index,
N is the number of cities;
w_{ij} is an element of the spatial balance matrix for the names of the hyons i and j;
μ - the average value of the indicator;
x is the analyzed measure.

3) Calculation of the mathematical expectation of the index:

$$E(I) = \frac{-1}{n-1} \tag{2}$$

where $E(I)$ is the mathematical expectation of the index,
n is the number of territories analysed.

4) Determination of the existence and nature of spatial autocorrelation.

$I_G \geq E(I)$ is a positive spatial autocorrelation (the values of the indicator in question are close to each other for neighbouring cities);

$I_G \leq E(I)$ is a negative spatial autocorrelation (the values of the indicator of neighboring cities differ).

$I_G = E(I)$ - no spatial autocorrelation [Rusanovskij, Markov, 2016].

5) Verification of the significance of the obtained results by the method of statistical hypothesis testing (z-test), by determining the value of Z-statistics:

$$z - stats = \frac{I - E(I)}{\sqrt{E(I)^2 - E(I)^2}} \tag{3}$$

The value obtained is the number of standard deviations by which the actual value of the Moran index is removed from the expected value.

6) Construction of the spatial Moran scatter diagram. The abscissa axis is the standardized z -values of the studied indicator, and the ordinate axis is the values of the spatial factor Wz. The diagram reproduces the regression line Wz by z, the slope of which is equal to the coefficient of total spatial autocorrelation I for a standardized weight matrix. The spatial autocorrelation coefficient demonstrates the degree of linear relationship between the z vector of centered values of the studied indicator and the Wz vector of spatially weighted centered values of the studied indicator in neighboring cities (regions) [29] (Fig.1).

Figure 1. Spatial dispersion diagram of the Moran index
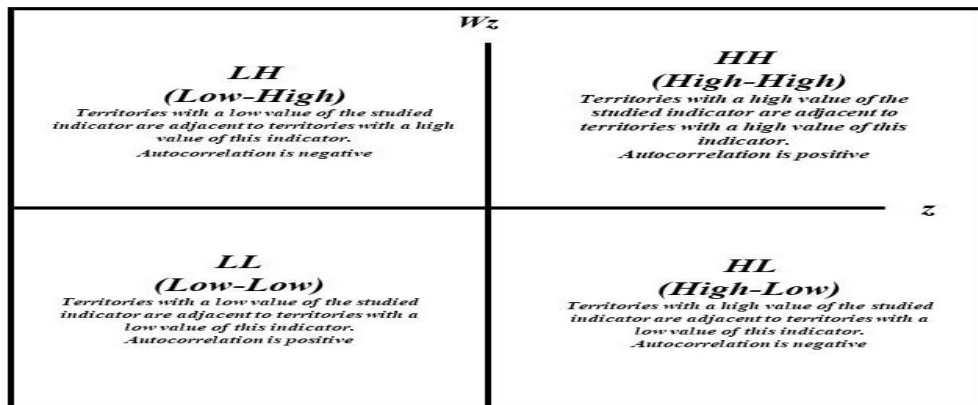
7) Calculate the values of the local Moran index *(LISA* - Local Index Spatial Autocorrelation), determine the tightness of a particular city's connection to all others.

$$I_{L_i} = z_i \sum w_{ij} z_j \qquad (4)$$

where
I_{Li} is the local Moran index for the *i*-city;
w_{ij} is the standardized distance between *i* -th and *j* -th city;
zi and *zj* are the standardised values for the *i*-th and *j*-th city.
The values obtained may range from -1 to 1.

For $I_{Li} < 0$, the negative autocorrelation for the city *i*. i.e. the given city by this value differs significantly from the neighbouring city (outlier).

For $I_{Li} > 0$, the autocorrelation is positive, i.e. the given city is similar to neighboring cities (cluster).

For $| I_{Li} | > | I_{Lj} |$- similarity/difference of cities *i* with surrounding neighboring cities is greater than for city j and its neighbors.

A sample of cities in the Southern Federal District with a population of more than 100,000 people was selected for the study. Poor municipal statistics and the lack of some indicators make it impossible to include the remaining group of cities in the analysis.

Analyzed indicators: population size, migration growth, volume of goods shipped per capita. Period of study - 2017. The source of the information was data from the Federal State Statistics Service; the distances were calculated from the data from the car portal.

4.   Results of the author's study and discussion

The indicators analyzed in the study are the resulting parameters for the socio-economic development of the city (fig. 2-4). Population size and migration growth are indicators of the success of urban development. Volume of goods shipped per capita - scale and success of economic activity of the city.

Fig. 2 Population of the cities of the Southern Federal District in 2017, thousands of people.
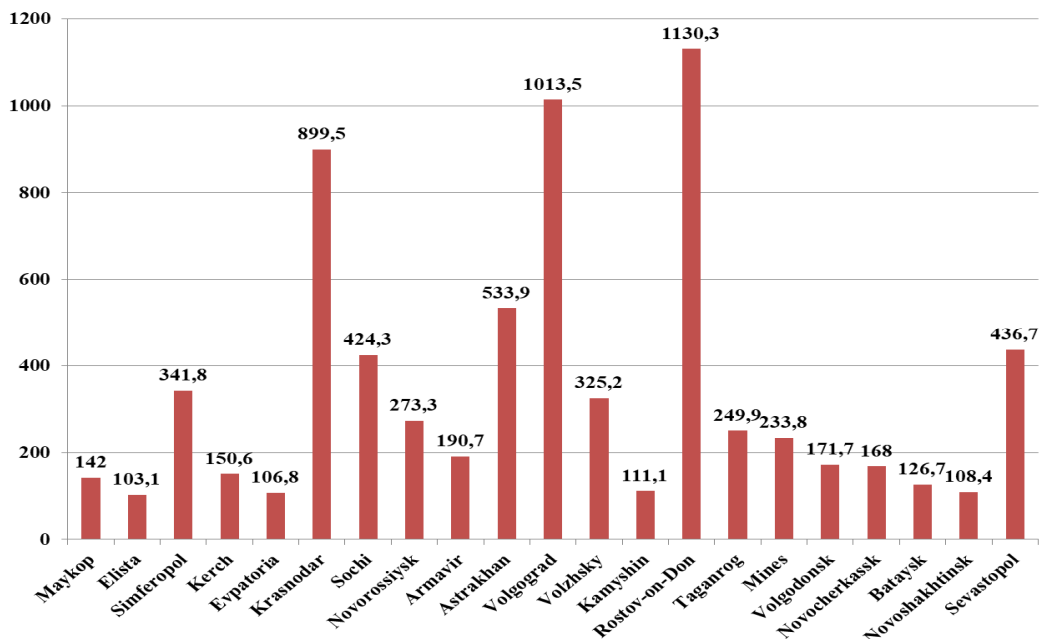
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

In the territory of the Southern Federal District in 2017, there are two millionaire towns. Rostov-on-Don and Volgograd. The largest share of the sample is in cities with less than 400,000 inhabitants. (15 cities). In general, data in figure 2 show a wide differentiation of the surveyed cities according to the index «population of the city»

Figure 3. Migration growth in the cities of the Southern Federal District in 2017, people
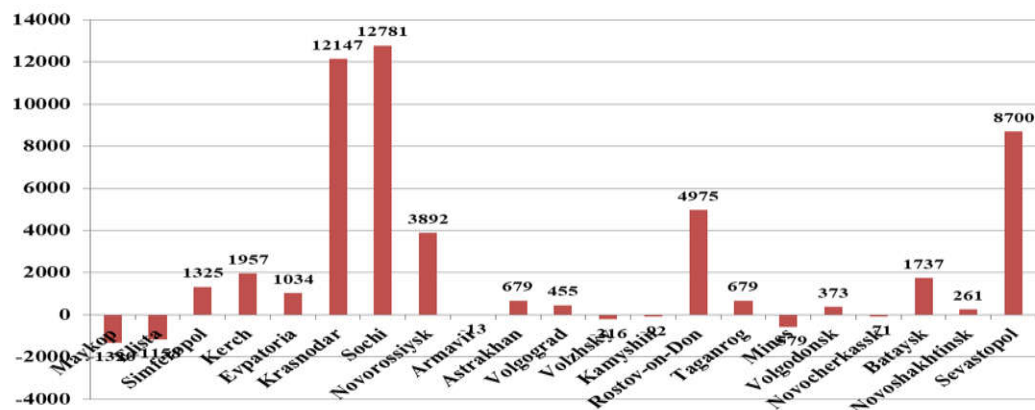
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

The figures in figure 3 show a mixed picture of migration growth in the cities of the Southern Federal District: some cities are experiencing a significant influx (Krasnodar, Sochi, Sevastopol), some are experiencing a significant decline (Maikop, Elista, Shakhty), which generally shows a wide differentiation of socio-economic development in the cities of the federal district surveyed.

Figure 4. Volume of goods shipped per capita in cities of the Southern Federal District in 2017, thousands of rubles.
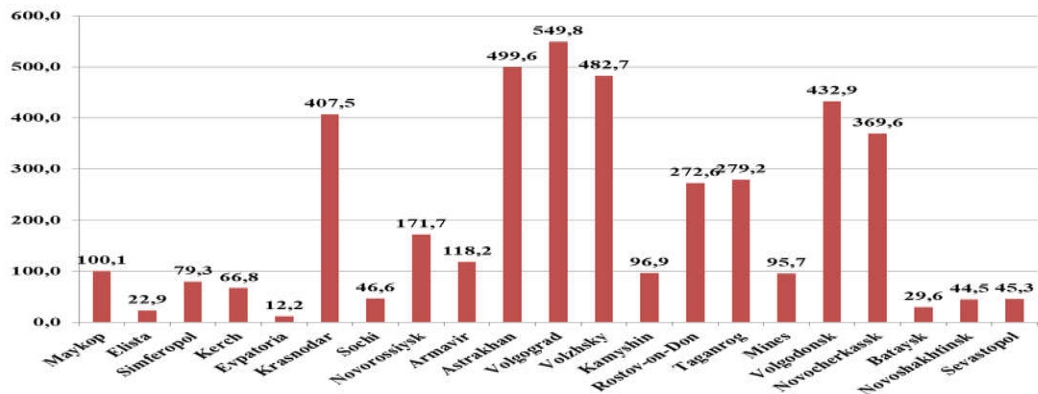
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

Maximum values of the index «volume of goods shipped per capita» are observed in Volgograd and exceed minimum values (Evpatoria) 45 times. In general, the cities leading on this indicator are Krasnodar, Astrakhan, Volgograd, Volga, Volgodonsk and Novocherkassk.

Figures 5, 7, 9 show the spatial scatter diagrams of the global Moran Index for the analyzed indicators in 2017 in the Cities of the Southern Federal District. Tabular representations of the local Moran index are given in tables 1-3. Graphical representations of the local Moran index of cities located in squares *HH* and *HL* are presented in figures 6, 8, 10.

Fig. 5 The spatial distribution of Moran (population) for the cities of the Southern Federal District in 2017.
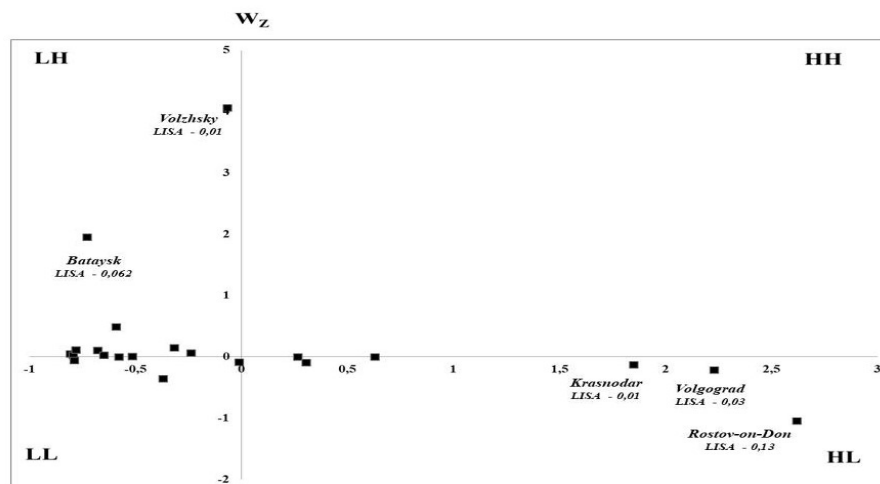
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

Table 1 Tabular representation of the spatial distribution of Moran for the cities of the Southern Federal District (population) in 2017.

	LH				HH		
City	**Z**	**Wz**	**LISA**	**City**	**Z**	**Wz**	**LISA**
Maykop	-0,67677	0,1038	-0,00335				
Elista	-0,80657	0,0463	-0,00178				
Kerch	-0,64807	0,0222	-0,00069				
Evpatoria	-0,79422	0,0275	-0,00104				
Novorossiysk	-0,23866	0,0576	-0,00066				
Armavir	-0,51427	0,0055	-0,00014				
Volzhsky	-0,06548	4,0635	-0,01267				
Kamyshin	-0,77987	0,1084	-0,00403				
Taganrog	-0,31673	0,1443	-0,00218				
Novocherkassk	-0,59001	0,4880	-0,01371				
Bataysk	-0,72782	1,9510	-0,06762				

LL				HL			
City	Z	Wz	LISA	City	Z	Wz	LISA
Simferopol	-0,01009	-0,09318	0,00004	Krasnodar	1,8508	-0,1307	-0,01
Mines	-0,37046	-0,3564	0,006	Sochi	0,2651	-0,0049	-0,001
Volgodonsk	-0,57767	-0,00115	0,0001	Astrakhan	0,63089	-0,0066	-0,002
Novoshakhtinsk	-0,78888	-0,05839	0,002	Volgograd	2,23118	-0,2145	-0,02
				Rostov-on-Don	2,62091	-1,0523	-0,13
				Sevastopol	0,3065	-0,0946	-0,01

Compiled from: Regions of Russia. Main socio-economic indicators of cities 2018: Stat. Sat. / Rosstat. - M., 2018.S., 172-208.

Figure 6 Local Index (*LISA*) Moran in a sample of cities of the Southern Federal District (population) in 2017.

A) Krasnodar

B) Sochi

C) Astrakhan

D) Volgograd

E) Rostov-on-Don

D) Sevastopol
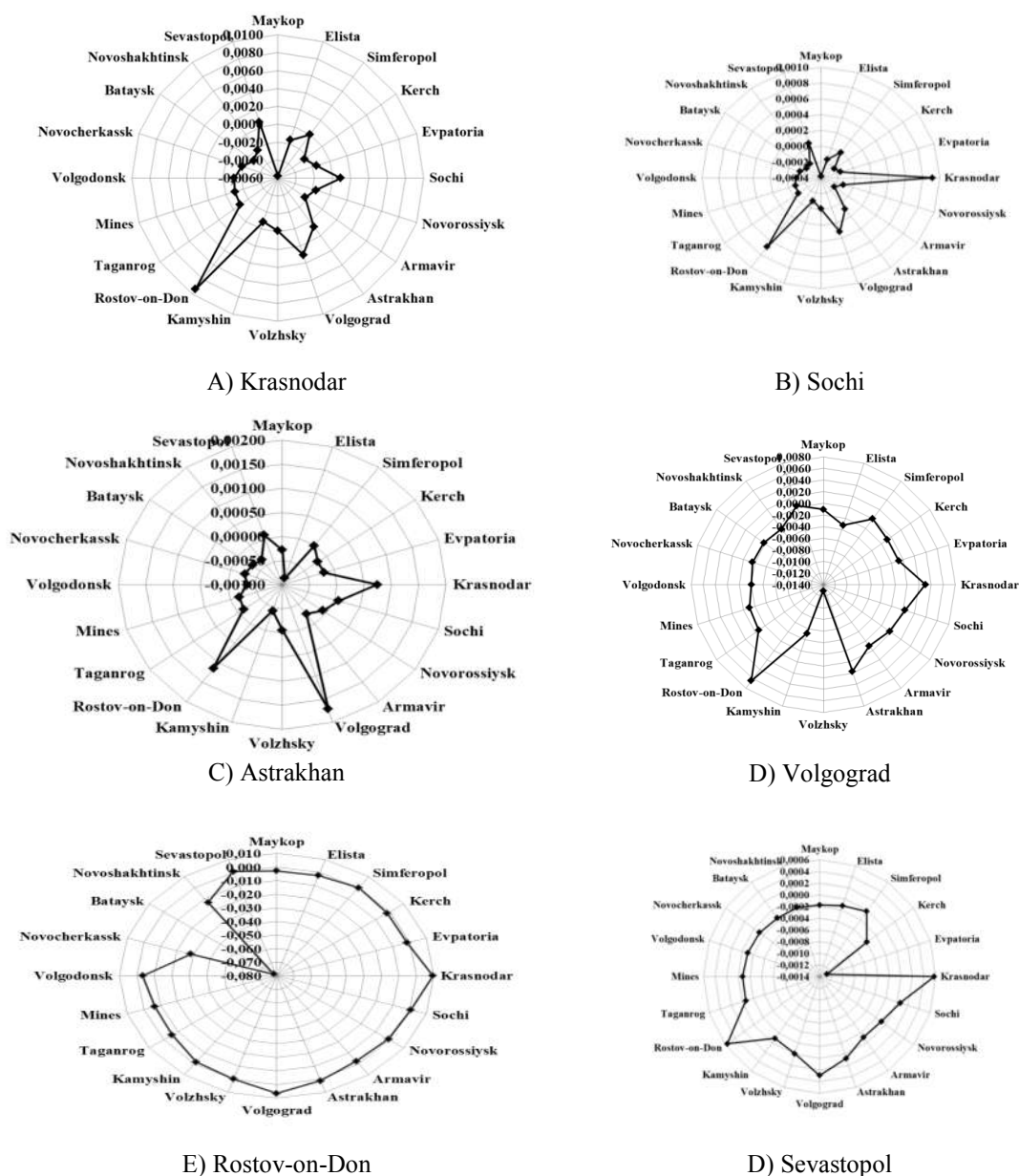
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

The population of the Southern Federal District obtained a global Moran index of -0.3 with a mathematical expectation of -0.05. Thus, we can conclude that there is a negative autocorrelation, i.e. neighboring cities are more likely to have different values for the

analyzed indicator. There are no cities in the Federal District with a relatively large population and no neighbors with a relatively high ratio. Five cities are located in the *HL* square, with the greatest interaction demonstrated by Krasnodar (*LISA* - 0.01146). The maximum number of cities in the different regions of the Federal District surveyed fell into the *LH* square. Three cities of Rostov Oblast and one republic of Crimea are located in the square *LL*.

Looking at the nature of the connections of cities with relatively high values of the measure (*HH* squared and *HL*), it was concluded that the strongest direct links between these cities were observed relative to each other (Figure 6): Rostov-on-Don-Krasnodar (*LISA* 0.009); Rostov-on-Don - Volgograd (*LISA* 0,006). The most powerful feedback for Rostov-on-Don is from Bataysk (*LISA* - 0.078); Krasnodar - Maykop (*LISA* - 0.0058); Sochi - Maykop (*LISA* -0.004); Astrakhan - Elista (*LISA* -0.001); Volgograd - Volga (*LISA* - 0.01); Sevastopol - Evpatoria (*LISA* -0.0013).

Thus, the presentation of the results of the calculations and their graphic display demonstrate a correlation by the index «population size» in the neighboring cities of the federal district being surveyed. An assessment of the effects of the relationships in the local Moran index of selected areas showed that there was a significant direct relationship between millionaire towns, while feedback was observed relative to the leading city and the nearby city with a population of less than 150 thousand people.

Figure 7. Spatial Moran Dispersion Diagram (migration growth) for the Southern Federal District cities in 2017.
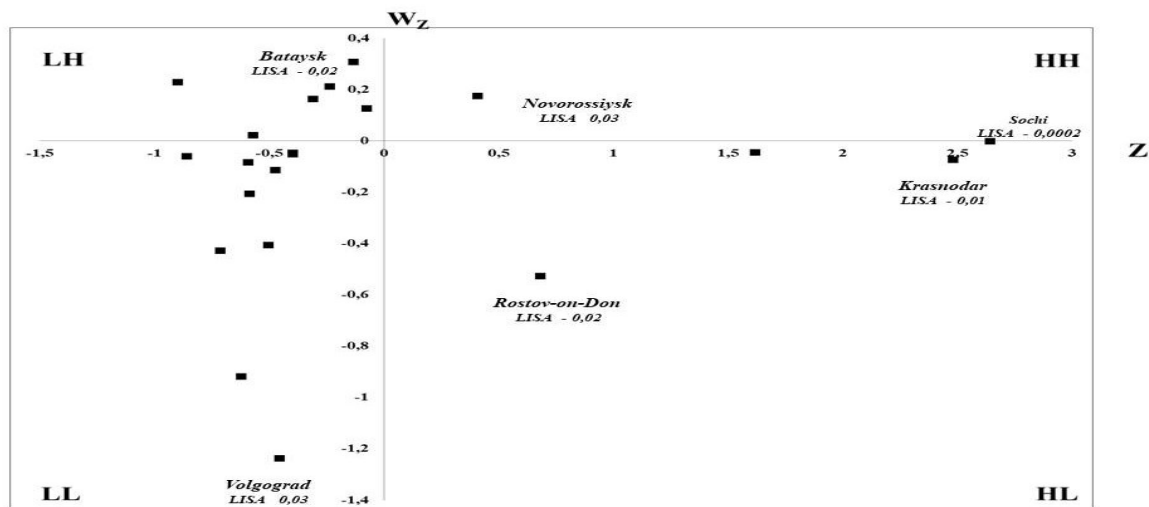
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

Table 2 Tabular representation of the Moran spatial dispersion diagram for the cities of the Southern Federal District (migration growth) in 2017.

LH				HH			
City	**Z**	**Wz**	**LISA**	**City**	**Z**	**Wz**	**LISA**
Maykop	-0,8996	0,22856	-0,00979	Novorossiysk	0,4086	0,1746	0,00339
Simferopol	-0,2357	0,21181	-0,00238				
Kerch	-0,0770	0,12550	-0,00046				
Evpatoria	-0,3087	0,16345	-0,0024				
Armavir	-0,5715	0,02131	-0,00058				
Bataysk	-0,1323	0,30673	-0,00193				

LL				HL			
City	Z	Wz	LISA	City	Z	Wz	LISA
Elista	-0,8589	-0,0608	0,00248	Krasnodar	2,480601	-0,0732	-0,0086
Astrakhan	-0,39786	-0,05192	0,000984	Sochi	2,639734	-0,00133	-0,00017
Volgograd	-0,4540	-1,2377	0,02676	Rostov-on-Don	0,680435	-0,5277	-0,0171
Volzhsky	-0,6225	-0,918	0,027214	Sevastopol	1,615407	-0,0454	-0,0035
Kamyshin	-0,5913	-0,0834	0,002349				
Taganrog	-0,3978	-0,0471	0,000894				
Mines	-0,7136	-0,4278	0,01454				
Volgodonsk	-0,4746	-0,1135	0,00256				
Novocherkassk	-0,5861	-0,2071	0,005782				
Novoshakhtinsk	-0,5027	-0,4071	0,009748				
Compiled from: Regions of Russia. Main socio-economic indicators of cities 2018: Stat. Sat. / Rosstat. - M., 2018.S., 172-208.							

Figure 8 Local Index (*LISA*) Moran in a sample of cities of the Southern Federal District (migration growth) in 2017.

A) Novorossiysk

B) Krasnodar

C) Sochi

D) Rostov-on-Don

E) Sevastopol
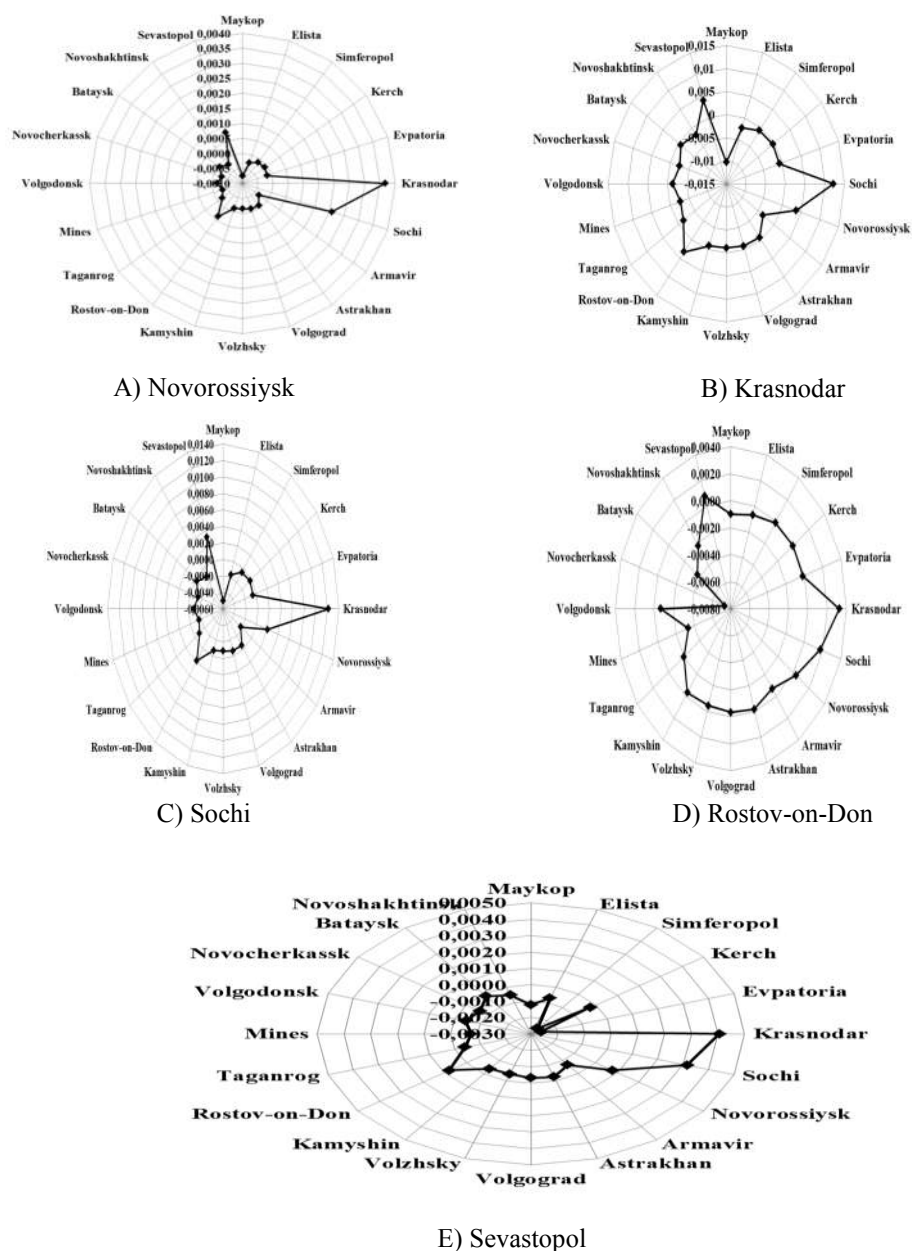
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

The global Moran index for urban migration in the Southern Federal District yields a value of 0.05, indicating a positive autocorrelation. As shown in figure 7 (square *HH*) and table 2, in the southern Federal district there is one city of Novorossiysk with a relatively high value of the indicator "migration growth", surrounded by territories that also have relatively high values of this indicator. Four cities (square *HL*) have relatively high migration growth, but their neighbors are characterized by a relatively low value of the analyzed indicator. Sixteen cities in the surveyed Federal district have a relatively low level of migration growth, six of which are surrounded by territories with a relatively high value of this indicator (*LH* square).

Analyzing the effects of connectivity of cities in the southern Federal district by the indicator "migration growth", we determined that the strongest direct connections are observed in the leading cities in this indicator located in territorial proximity (Fig.8): Novorossiysk – Krasnodar (*LISA* 0.004); Krasnodar – Sochi (*LISA* 0.01); Rostov-on-don – Krasnodar (*LISA* 0.003), the exception is Sevastopol – Krasnodar (*LISA* 0.004) distance 526 km.

Looking at the feedback from the territories on the rate of migration growth, the strongest effect was found in relation to Mykop. The exception is Sevastopol, for this city strong feedbacks were found in relation to *Y*evpatoria (*LISA* -0.003), Simferopol (*LISA* -0.003).

Thus, the "core" of the "migration growth" indicator was determined in the southern Federal district, which includes Novorossiysk, Krasnodar, Rostov-on-don, Sochi, and Sevastopol. A significant factor for the influx of population to these cities is a favorable warm climate, a relatively high level of economic development, which generally determines the quality of life. Maykop and Yevpatoria experience the greatest «force of attraction» of these cities.

Figure 9 Spatial Distribution Diagram of Moran (per capita product shipped) for cities of the Southern Federal District in 2017
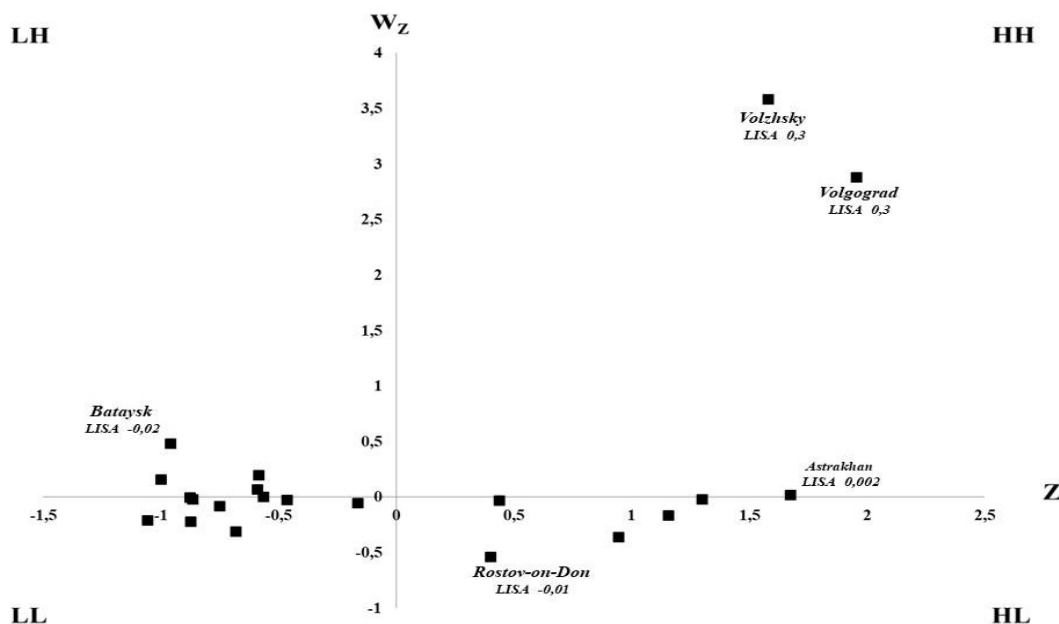
Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

Table 3 Tabular representation of the spatial distribution of Moran for the cities of the Southern Federal District (per capita value of goods shipped) in 2017.

LH				HH			
City	**Z**	**Wz**	**LISA**	**City**	**Z**	**Wz**	**LISA**
Maykop	-0,5662	0,0026	-0,00007	Astrakhan	1,67297	0,0196	0,0015
Elista	-0,9993	0,1628	-0,00775	Volgograd	1,95472	2,8851	0,2685
Kamyshin	-0,5843	0,2012	-0,0056	Volzhsky	1,57865	3,5886	0,26977
Mines	-0,59104	0,0719	-0,0020				
Bataysk	-0,96134	0,4830	-0,02211				

LL				HL			
City	Z	Wz	LISA	City	Z	Wz	LISA
Simferopol	-0,682	-0,3062	0,0099	Krasnodar	1,15685	-0,161	-0,00
Kerch	-0,752	-0,0812	0,00291	Volgodonsk	1,29925	-0,016	-0,001
Evpatoria	-1,059	-0,2076	0,01048	Novocherkassk	0,94450	-0,358	-0,0161
Sochi	-0,866	-0,0181	0,00075	Rostov-on-Don	0,40068	-0,537	-0,016
Novorossiysk	-0,164	-0,054	0,00042	Taganrog	0,4375	-0,031	-0,0007
Armavir	-0,4649	-0,024	0,00053				
Novoshakhtinsk	-0,8779	-0,0001	0,000001				
Sevastopol	-0,8733	-0,2189	0,00910				
Compiled from: Regions of Russia. Main socio-economic indicators of cities 2018: Stat. Sat. / Rosstat. - M., 2018.S., 172-208.							

Figure 10 Local Index (*LISA*) Moran in a sample of cities in the Southern Federal District (per capita product shipped) in 2017.
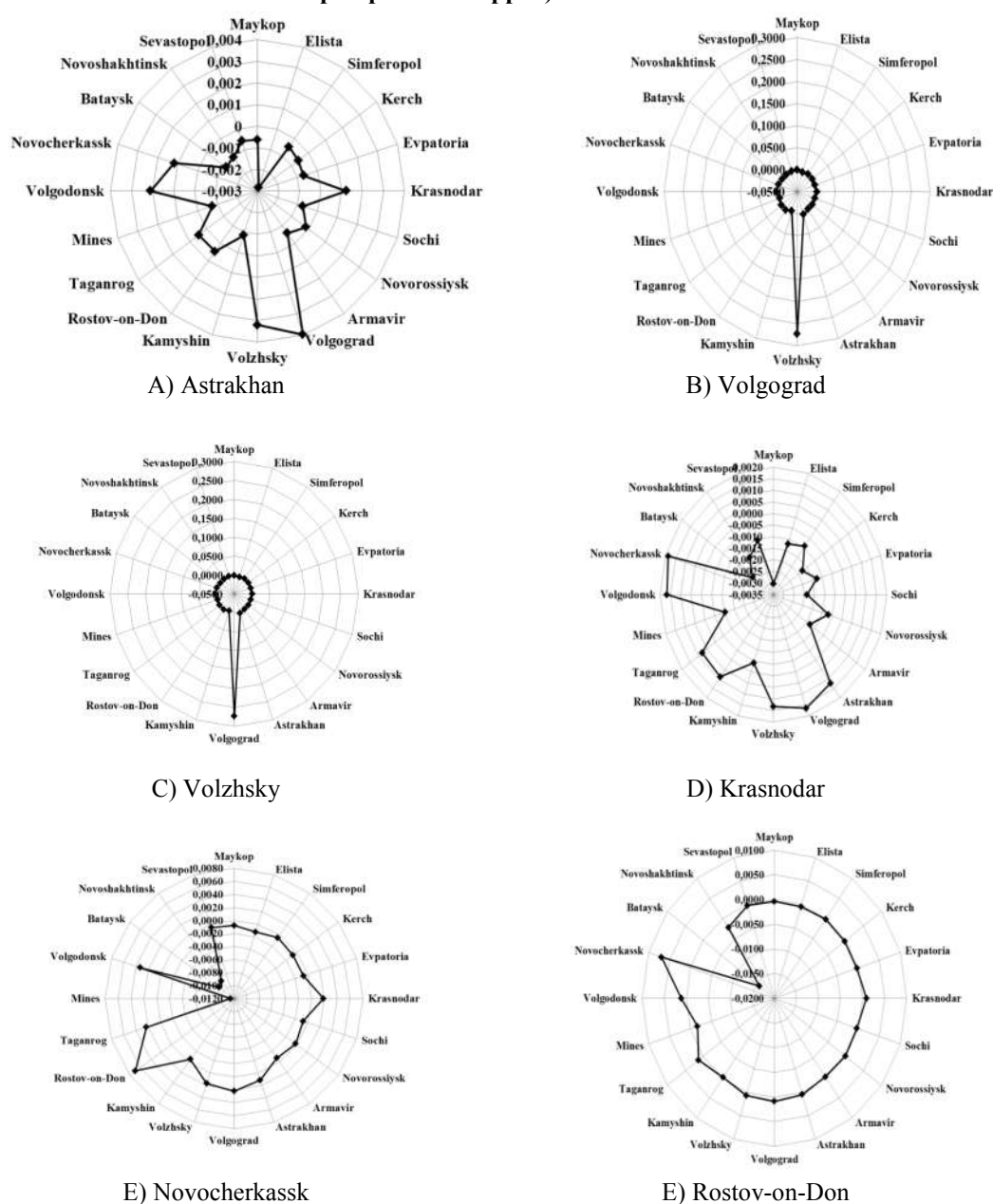
A) Astrakhan

B) Volgograd

C) Volzhsky

D) Krasnodar

E) Novocherkassk

E) Rostov-on-Don

Compiled according to: Regions of Russia. The main socio-economic indicators of cities 2018: stat. compendium / Rosstat. − M., 2018. S, 172-208.

Spatial autocorrelation assessment based on data from the analysis of per capita shipped output in the cities of the Southern Federal District, indicates that there is a direct relationship between the values of this indicator in the vicinity. Such conclusions make it possible to compare the value of the global Moran index (0.5) with its mathematical expectation (-0.05). According to figure 9, the presence of two leaders Volga and Volgograd is clearly visible. Volzhsky is a major industrial center of the South of Russia, where competitive industries are developing: energy, chemical, mechanical, light and food industries. The level of competitiveness of the Volgograd industry determines the energy complex represented by a number of power plants.

The largest share of the total number of cities is occupied by territories with positive autocorrelation (group LL), which are not influenced by the surrounding territories. The LH squared five cities in different regions of the Southern Federal District.

Considering the connections of cities-leaders of the Southern Federal District according to the index «volume of goods shipped per capita», determined that positive effects manifest in the cities under consideration relative to each other. The data in figure 10 show a significant difference in the extent of backward clump in leading cities. In Volgograd and Volga (fig. 10 «B», «C») when there is a strong direct connection relative to each other, there are no significant opposite inter-territorial effects. Strong inverse spatial effects for city leaders are observed in relation to nearby territories: Krasnodar - Maykop (*LISA* -0.003); Novocherkassk - Shakhty (*LISA* -0.01); Rostov - na-Don - Bataysk (*LISA* -0.01).

5. __Conclusion__

The study revealed the presence of direct and inverse spatial relationships in the cities of the southern Federal district. There is a negative autocorrelation for the indicator "population", a positive autocorrelation for the indicator "migration growth" and "volume of products shipped per capita". According to the indicator of the volume of products shipped per capita, polarization was revealed: Volgograd and Volzhsky are separated from the rest of the group of cities and have strong direct links relative to each other, while they do not have a significant impact on the surrounding territories.

The strongest direct inter-territorial links were found in the group of leading cities relative to each other. Significant reverse effects are observed for the indicator "migration growth" largely Maikop falls into the zone of influence of the leading cities. Based on a joint analysis of the local Moran index for the indicator "population" and "migration growth", it is possible to assume that the population migrates from this city to Krasnodar and Sochi. Proximity to major cities-leaders in socio-economic parameters contributes to the outflow of population from medium and small cities, increasing differentiation.

To reduce inter-territorial socio-economic differences, it is advisable to develop territories adjacent to the leading cities. Modernization of infrastructure, active social policy, improvement of the quality of life of the population, implementation of programs to attract young professionals will contribute to improving the competitiveness of cities, sustainable development of regions and the country as a whole. The factor that determines the choice of residence of the working-age population is the availability of jobs, the level of remuneration of which meets the requirements of employees. It is important to note that these measures should be carried out throughout the Russian Federation, so as not to increase the unevenness and isolation of individual regions.

The scientific significance of the research consists in the development of theoretical and methodological provisions regarding the assessment of spatial inter-territorial relations, identification of leading cities, and the zone of their influence. In the future, we will continue to study autocorrelation in dynamics, expand the analyzed indicators, and identify spatial and temporal shifts in order to better understand the patterns of spatial development of cities.

The practical significance lies in the possibility of using the results obtained by regional authorities when developing a strategy for the development of cities and regions in terms of identifying production clusters in the region.

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TECHNOLOGIZATION PROCESSES AND SOCIAL AND ECONOMIC GROWTH: MODELING THE IMPACT AND PRIORITIES FOR STRENGTHENING THE TECHNOLOGICAL COMPETITIVENESS OF THE ECONOMY

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Abstract
The methodology of integral assessment of the technological competitiveness state of the economy has been developed, which includes a system of indicators in the areas of the country's readiness for economy digitization, the quality of innovation activity institutions, the state of digital knowledge dissemination. The integral values of technological competitiveness of the economy for the countries of the European Union and Ukraine have been calculated. A dynamic grouping of countries according to the level of technological competitiveness of the economy has been carried out. Modelling the impact of the parameters of technological competitiveness of the national economy on the basic parameters of social and economic development such as GDP per capita, share of high-tech exports, capital investment and quality of life of population has been realized. The strategic priorities and means of introduction of the collective contractual organizational and institutional system for providing technologization in the processes of social and economic growth of the country (the casestudy of Ukraine) are substantiated.
Keywords: innovation and technological development, competitiveness of the social and economic system, economic integration, prerequisites, factors of technologization
JEL classification: O32, O38, O47, C18, C51

1. **Introduction**

At present, there is a strong belief that economic growth and improving the quality of life of the population are directly determined by the level of competitiveness of the national economy and the processes of globalization only reinforce this hypothesis. Due to this development, the connections between the systematic introduction of technological innovations and the strengthening of the competitiveness of the national product have been axiomed, which is especially important in the era of digitization. Maximizing efficiency and increasing the rate of strengthening technological competitive advantages requires an understanding of the closest correlations of state policy to intensify the development of technological processes and ensure social and economic growth.

The modern period is characterized by such systemic negative trends as loss of a number of strategically important spheres of the real sector of the economy, deindustrialization, limited production of innovative and high-tech products, raw material export orientation and declining competitiveness in the world markets, high import dependence of domestic consumption. One of the key reasons for the emergence and increase of these trends lies in the reduction of innovation, scientific and technological activities and in the decrease of business demand for modern research and development, the isolation of education and science from the manufacturing sector, the decline of innovation and technological infrastructure. The innovation and technological potential of the national economy has significantly weakened as well.

The social and economic growth and intensification of the competitive positions of the economy requires the implementation of a balanced state policy aimed at strengthening the technological competitiveness of the economy as a leading component of the formation and strengthening of competitive advantages, which characterizes the modernity and progressiveness of used technologies, their spread in the economy and society, quality of the production system, involvement and implementation of advanced technologies, availability of resource supply (primarily investment and financial, intellectual and personnel, technical and technological, educational, research and information one), the effectiveness of the results of innovation and technological activities.

The substantiation of methodical approach to modeling the influence of consequences of the state policy of maintaining the technological competitiveness on social and economic development of economy acquires important theoretical and applied value that, unlike traditional approaches, expects a complex analysis (its information and analytical basis is numerical values of the sub-indices of the Global Innovation Index and the World Index of Digital Competitiveness of the Economy), which provides the calculation of the level of technological competitiveness of the country's economy and the implementation of comparative analysis with other high-tech countries, including EU countries. A thorough applied methodological approach allows clustering and identifying the positions of countries in terms of technological and innovative development, identifying the degree of divergence in terms of technological competitiveness, visualizing problem areas and reserves of state policy to strengthen the technological competitiveness of the economy.

Approbation of this type of methodological approach creates a more informative and analytical basis for substantiating the functions, tools and objectives of the state policy of collective contractual organizational and institutional system to ensure technological competitiveness of the economy as a fundamentally new approach in this area, involving joint efforts and delegation of functions and tasks between the state, associative business structures, education, science and innovation institutions, civil society to share areas of responsibility for the implementation of the main functions of the technologization processes of the national economy.

2. **Literature Review**

Both the justification of direct links and the study of various aspects of the impact of innovation and technological development on the economic growth of the country have always been the focus of scientific research. For example, innovative changes and their impact on the development of EU regions are quite thoroughly described in the work by R. Ciborowski, I. Skrodzka (2020); the direct connection between the creation and

implementation of advanced technologies and ensuring the competitiveness of the national economy are covered by J. Fagerberg (1996); A. Khryseva, E. Akimova, A. Savchenko (2018) investigated the direction of investment resources on innovation and technological development and ensuring the competitiveness of the economy.

Understanding the non-alternative way of technologization of the economy as a key to ensuring competitiveness and social and economic growth has led to a number of studies in the field of identifying, on the one hand, factors (O. Levytska, O. Mulska, U. Ivaniuk, M. Kunytska-Iliash, T. Vasyltsiv, R. Lupak (2020), O. Mulska, O. Levytska, V. Panchenko, M. Kohut, T. Vasyltsiv (2020)), and, on the other hand, obstacles to systemic innovation and technological economic growth (M. Burhanuddin, F Arif, V. Azizah, A. Prabuwono (2009), S. Hrynkevych, T. Vasyltsiv (2015), economic growth (N. Hossain, Y. Miyata (2012), T. Yalyalieva, D. Napolskikh (2017), Z. Almeida, I. Scheuneman, T. Sequeir, F. Diniz (2017)). Current trends of globalization have made it especially important to develop theoretical and methodological foundations of the state policy of preserving intellectual and personnel support for the creation and implementation of technological innovations in terms of reducing barriers to migration mobility of population.

It should be noted that firstly scientists paid more attention to expanding the typology of innovations. Thus, the classic product and technological innovations were complemented by environmental (S. Borghesi, V. Costantini, F. Crespi (2020)), technological and environmental (T. Requate, W. Unold (2003), S. Khanam, A. Islam, M. Megat, A. Jaafar (2015)), consumer (L. Rubalcaba, S. Michel, J. Sundbo, S. Brown, J. Reynoso (2012)), management (A. Triguero, M. Cuerva, C. Álvarez-Aledo (2017), H. Duran (2015)), social ones (R. Van der Have, L. Rubalcaba (2016), P. Aliha, T. Sarmidi, F. Faizah (2019)) etc. However, it has been further deepened the understanding that a number of them provide a technological breakthrough, while others serve as factors in supporting the innovation and technological development of the economy. Due to this, nowadays, theoretical and applied research directly in the field of technological innovations as a key driver of national competitiveness and economic growth are becoming increasingly important.

However, this is just a theory and only few works concern the empirical proof of not just the connection, but also the specific consequences, the level of impact of technologization on economy, creation, import and introduction of advanced technologies on certain basic parameters of economic and social development in the country. The exceptions are the publications by B. Jun-hong (2013), A. Mohamed, S. Sapuan, M. Ahmad, A. Hamouda, B. Baharudin (2012), C. Zhang, B. Wang, W. Gao (2017), L. Liubokhynets, Ye. Rudnichenko, I. Dzhereliuk, O. Illiashenko, V. Kryvdyk, N. Havlovska (2020), P. Numes, P. Nijkamp (2010, 2011) where an attempt was made to empirically assess the impact of trends in technologization (in various forms and areas such as ecology, oil production, labor market, export potential of industry etc.) to increase GNP and exports, as well as value added in purely raw materials industries, replace manual labor with automated one and at the same time create new digital employment niches, form new industries, and ensure the consumption security.

It should be emphasized that further improvement of the methodology of modeling technological processes and social and economic growth is necessary not only to understand the relevant relationships and interactions, but also to develop more means that are effective, tools, and mechanisms of state policy to strengthen them. Thus, it is paid attention to the works by B. Bozeman (2000), N. Khabiri, S. Rast, A. Senin (2012), P. Mohnen, L-H. Röller (2005), S. Ahmed, Yu. Ypanaque (2011) where it is convincingly argued on the economic, organizational and institutional capabilities of the state regarding the implementation of policy to stimulate internal technologization of the economy and technology transfer, as well as the complementarity of innovation progress at the regional and local levels. On the other hand, the statements of the theory of innovation policy integration (A. Pelkonen (2006)), institutionalism (S. Serger, E. Wise, E. Arnold (2015)) and adsorption of global experience (K. Smith (2016)) are now becoming increasingly clear.

At the same time, we are convinced that at present there are not enough scientific and applied developments in the field of modeling the impact of the technologization processes of the economy on the basic parameters of economic and social development. In their development and improvement, it is important to rely on already proven links of a qualitative

nature, in particular in terms of the impact on employment (F. Bogliacino, M. Pianta (2010)), quality of life (L. Gagliardi, G. Marin, C. Miriello (2016)), export potential (O. Jean, M. Ashoka (1996)), domestic production and consumption (G. Korres, A. Kokkinou (2011)), consumer market development (T. Waroonkun, R. Stewart (2008)), regional and local development (E. Zakharova, E. Kardava, R. Avanesova, E. Avramenko (2015)).

The aim of the study is to develop a methodological approach to modeling the impact of the processes of technologization of the economy on the basic parameters of economic and social development of the country (the case study of Ukraine).

The hypothesis is an effective state policy to stimulate the creation and implementation of technological innovations being a driver of accelerating GDP growth, increasing the share of high-tech exports, rising capital investment and improving the quality of life.

3. <u>Research Method</u>

Modeling the impact of the processes of technologization of the economy on the basic parameters of social and economic development of the EU and Ukraine consists of three key stages, namely assessing the level of technological competitiveness of the economy, assessing the relationship between technological competitiveness and economic growth of the country, modeling alternatives to social and economic growth in Ukraine providing the corresponding values of technological development of individual EU countries (Figure 1).

Figure 1: Methodical stages for modeling the impact of the processes of technologization of the economy on the parameters of social and economic growth
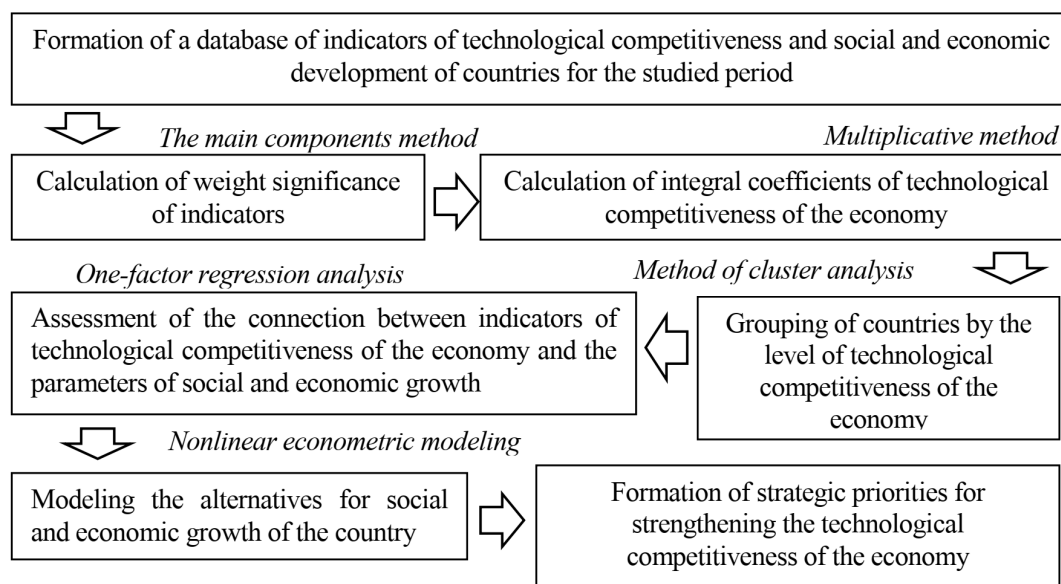
Source: authors' development

The initial stage of the authors' methodology of calculating the integral coefficient of technological competitiveness of the economy is the selection of indicators that demonstrate the key parameters of innovative development, conditions of access to new technologies and resource support of the technology transfer process. The system of information and analytical support is formed from the sub-indices of the Global Innovation Index, the World Index of Digital Competitiveness and Talents during 2016-2018 (Table 1). The process of forming the research base was based on the principles of validity, universality, and comparability.

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Table 1. The system of information and analytical support for the analysis of the processes of technologization of the economy and the basic parameters of social and economic development

Economy technologization indicators	Variables of social and economic development
Global Innovation Index	
INST – institutions; CAPIT – human capital and research; INFR – infrastructure; MARKET – market sophistication;	
Global Talent Competitiveness Index	
CONECT – business sophistication; OUTPUT – knowledge and technology outputs; RESUL – creative outputs; COND – market, business and labour landscape; ABILITY – ability to attract talent; GROWTH – access to growth opportunities; RETAIN – ability to retain highly-skilled professionals; VTS – vocational and technical skills; GLOBAL – global knowledge skills;	GDP – gross domestic product per capita in PPP terms; EXPORT – share of high-tech exports; INDEX – Global Quality of Life Index
World Digital Competitiveness Index	
KNOWL – knowledge; TECHN – technology; READY – future readiness	

Source: authors' development

The calculation of the *weight significance of the indicators* is carried out using the method of main components based on formula (1):

$$w_i = |MC_i| \ / \ \sum_i^n |MC_i|, \tag{1}$$

where w_i is the weight of i- indicator of technologization of the economy;
MC_i is the value of the main component of i- indicator;
n is the number of indicators.
Integral coefficients of technological competitiveness of the economy are calculated based on the multiplicative method by formula (2):

$$Coef_t^j = \prod_{i=1}^{n} Ind_{it}{}^{w_i} \tag{2}$$

where $Coef_t^n$ is an integral coefficient of technological competitiveness of the economy of j- country in t- time interval;
Ind_{it} is an i- indicator of the technologization of the economy in the t- time interval.
The use of analytical data of global rankings to analyze the impact of selected sub-indices on economic and social development allow tracking and confirming (refuting) the relationship between indicators-characteristics of technological competitiveness of the national economy and social transformations of the economy.
In order to confirm the hypothesis of the dependence of social and economic growth of the country on the level of technologization of the economy, the empirical assessments of the impact of technological competitiveness of the economy, innovation, digitalization of the economy and the formation of intellectual staff support on the basic parameters of

economic and social development have been conducted. Assessment of the impact of activation processes of systemic technologization of the national economy on the parameters of economic growth and development of the social sphere has been carried out based on model (3):

$$Parm_t = a + bInd_t \qquad (3)$$

where $Parm_t$ is a parameter of social and economic growth of the country in t- time interval.

The confirmation of the high density of relationships between the studied variables is presented in Table 2.

Forecasting models of the economic growth of the country are described by functions (4) and (5).

$$Parm_t = a\cos(2Ind_t) - b\sin(Ind_t), \qquad (4)$$

$$Parm_t = \frac{1}{a - b\ln(Ind_t)}, \qquad (5)$$

Table 2. Indicators of significance of modeling the impact of technologization of the economy on the social and economic development of Ukraine

Criterias		Parm$_t$	Ind_t										
			CAPIT	OUTPUT	INFR	CONECT	RESUL	COND	ABILITY	GLOBAL	KNOWL	TEHN	READY
Adjusted R-squared		GDP	0.904		0.437	0.432	0.858	0.997		0.930	0.519	0.926	0.985
		EXPORT	0.991				0.664	0.927		0.998		0.769	0.887
		INDEX	0.896	0.485				0.557	0.786	0.865			0.476
Standard regression error		GDP	0.023		0.056	0.057	0.028	0.004		0.020	0.052	0.020	0.009
		EXPORT	0.006				0.036	0.017		0.003		0.030	0.021
		INDEX	0.009	0.019				0.018	0.012	0.010			0.019
Sum squared resid		GDP	0.001		0.003	0.003	0.001	0.000		0.000	0.003	0.000	0.000
		EXPORT	0.000				0.001	0.000		0.000		0.001	0.000
		INDEX	0.001	0.000				0.000	0.000	0.000			0.000
Log likelihood		GDP	8.676		6.025	6.014	8.095	13.83		9.159	6.264	9.064	11.47
		EXPORT	12.73				7.342	9.631		14.75		7.904	8.983
		INDEX	11.69	9.289				9.513	10.60	11.29			9.262
F-statistic		GDP	19.79		2.550	2.524	13.10	646.6		27.68	3.162	25.92	132.8
		EXPORT	215.42				4.945	26.35		828.4		7.645	16.75
		INDEX	18.274	2.886				3.511	8.335	13.79			2.816
p-value		GDP	0.014		0.036	0.036	0.017	0.003		0.012	0.033	0.012	0.006
		EXPORT	0.043				0.027	0.012		0.022		0.002	0.015
		INDEX	0.146	0.339				0.312	0.212	0.168			0.342
SE of dependent variable		GDP	0.075		0.075	0.075	0.075	0.075		0.075	0.075	0.075	0.075
		EXPORT	0.063				0.063	0.063		0.063		0.063	0.063
		INDEX	0.026	0.026				0.026	0.026	0.026			0.026
Information criterions	Akaike	GDP	-4.451		-2.684	-2.67	-4.063	-7.890		-4.773	-2.842	-4.71	-6.31
		EXPORT	-7.16				-3.56	-5.09		-8.50		-3.94	-4.66
		INDEX	-6.46	-4.85				-5.00	-5.73	-6.19			-4.84
	Schwartz	GDP	-5.052		-3.284	-3.27	-4.664	-8.491		-5.374	-3.443	-5.31	-6.91
		EXPORT	-7.75				-4.16	-5.68		-9.10		-4.53	-5.25
		INDEX	-7.06	-5.46				-5.60	-6.33	-6.79			-5.44
	Hannan-Quinn	GDP	-5.659		-3.892	-3.88	-5.271	-9.098		-5.981	-4.050	-5.91	-7.52
		EXPORT	-8.36				-4.76	-6.29		-9.70		-5.14	-5.86
		INDEX	-7.66	-6.06				-6.21	-6.94	-7.40			-6.04

Source: authors' own complications using EViews 11 software. Note: SE is standard error

4. Results and discussion

4.1. Empirical research results

Innovation activity, its scale, trends, structural characteristics and efficiency are the basic prerequisites for the formation of technological competitiveness of the national economy. Technology transfer, commercialization of scientific developments and innovations, as well as other forms of diffusion of modern advanced knowledge and know-how determine the environment of supply of advanced technologies, their implementation and use strengthens technological competitiveness of individual enterprises, industries and types of economic activity, as well as the country's economy as a whole. Instead, the innovation and technological activity in Ukraine is at a low level, and the dynamics of numerous indicators of innovation and technological development indicates a downward trend, which negatively affects the formation and realization of the potential for technological competitiveness of the national economy. This conclusion is confirmed:

- in statics by a small share of industrial enterprises engaged in innovation (15.8% in 2019), which implement innovations (13.8%) and sell innovative products (14.2%), by a low share of innovative products in total sales of industrial products (1.3%) and its exports (3.8%), by limited funding for innovation (0.47% of GDP), the presence of marked structural shortcomings in financing and spending on innovation, sources of attraction (acquisition, transfer) of new technologies, directions of development of innovation and technological activity, as well as by worse indicators of innovation and technological development in the small business sector;

- in dynamics by a decrease in the number of industrial enterprises that carried out innovative activities (by 46.5% in 2010-2019) and implemented innovations (by 43.5%), by a reduction in the number of introduced innovative products (goods, services), by industrial enterprises (by 10.8%) and the share of innovative products in the total volume of sold industrial products (by 2.5 percentage points), a decrease in the number of enterprises that sold innovative products outside Ukraine (in 2 times), and the volume of such products (in 2.5 times).

The result of these trends is the low position of the Ukrainian economy in the rankings of leading international organizations on competitiveness indices, including innovation and technology one – Global Competitiveness, World Competitiveness Index, Digital Competitiveness, Global Innovation Index, International Index of Property Protection, etc.

The most informative form of presenting the results of research in the field of technological competitiveness of the economy, in particular for a comprehensive description of the situation and tracking its trends is the calculation and presentation of integral indicators (coefficients). This method of research allows integrating the parameters differentiated by the research problem into a single system. The applied value of integral assessments is to enable a comparative analysis of the level of technological competitiveness of leading high-tech enterprises, industries and sectors of the economy, economic activities, regions and countries; to assess the effectiveness of public policy in this area, as well as to signal the improvement of the environment of technological development or, conversely its deterioration.

Based on certain weight coefficients of key parameters that describe the level of technologization of the economy on the example of the EU and Ukraine (Figure 2), it is established that the state of technological competitiveness of the economy determines the country's readiness for digital economy, the quality of innovation institutions and digital knowledge. Together, these three factors determined the state of technological competitiveness of the economy of the EU and Ukraine in 2018 at 32.25%, in particular by factors; the weight significance was 11.24%, 10.68%, 10.33%, respectively. It should be emphasized that the levels of importance of these factors were the highest in 2016 and 2017, which serves as a confirmation of the high relevance of the development of the digital information technology sector and the infrastructure of innovation and technology in Ukraine.

Figure 2: Weight coefficients of indicators of technological competitiveness of the economy, 2016-2018.
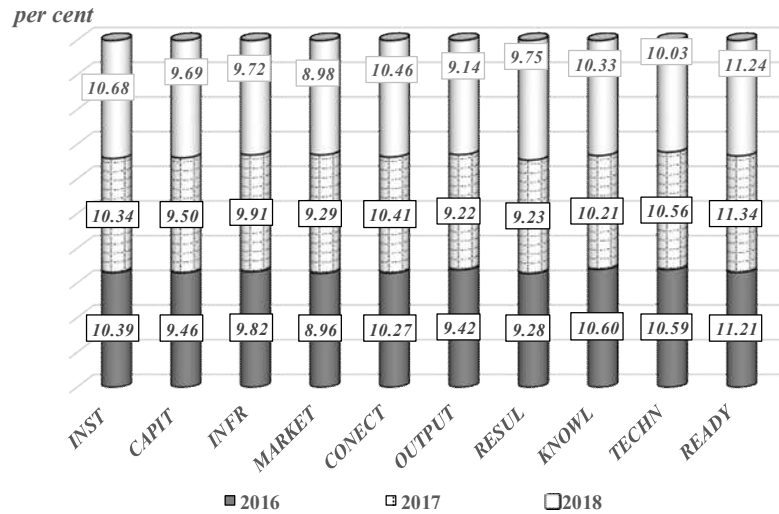
Source: authors' own complications by formula (1)

At the same time, other components of the index have a significant impact on the level of technological competitiveness of the economy, in particular it is the quality of the market environment (8.98% in 2018 and 8.96% in 2016), the results of knowledge and technology application in the economy (9.14 % in 2018 and 9.22% in 2017), the use of intellectual creativity (9.23% in 2017 and 9.28% in 2016).

The results of the calculations have confirmed the lowest competitive advantages for the economy of Ukraine compared to other EU countries (in 2018 the value of the integral index was 0.542). Among the EU-28 countries in 2018, the lowest positions of technological competitiveness were occupied by Romania with an integral coefficient of 0.554, and the highest one by the Netherlands (0.933). In 2016, the leading country in terms of the level of technological competitiveness of the economy was Sweden with an integral coefficient of 0.936 (0.928 in 2018). It should be noted that the countries with the level of technological competitiveness of the economy above the average in 2018 included the Netherlands, Sweden, Finland, Denmark, Great Britain, France, Germany, Ireland, Luxembourg, Austria, Belgium, the Czech Republic, Spain and Estonia (Figure 3).

Figure 3: Integral coefficients of technological competitiveness of EU countries and Ukraine, 2016-2018
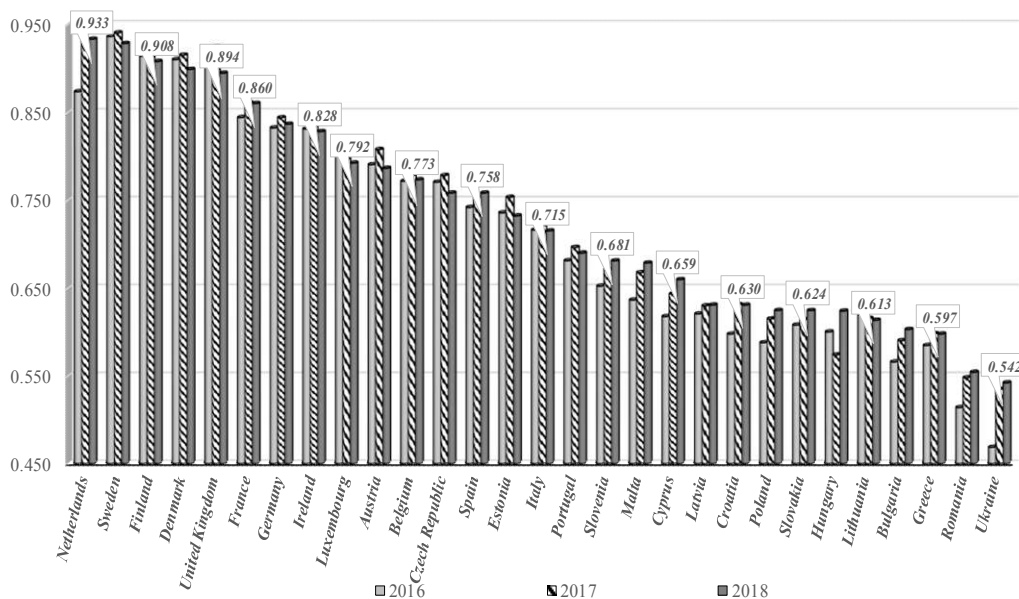
Source: authors' own complications by formula (2) ranked by the values of integral indices in 2018

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It should be stressed that for most EU countries there is an increase in the level of technological competitiveness of the economy in 2016-2018 (Figure 4). The largest increase in the integral coefficient of technological competitiveness (at 1-1.1% level) was characteristic for the Netherlands, Malta, Cyprus, Bulgaria, Croatia, Poland, and Slovenia. This trend is an evidence of the intensification of innovation in recent years and the growing level of commercialization of research in the EU countries, which previously had a relatively lower level of economic development among the studied countries.

However, there is a downward trend in the level of technological competitiveness of the economy (about 1%) for the economies of Sweden, Finland, Denmark, Great Britain, Ireland, Luxembourg, Austria, the Czech Republic, Estonia, Italy and Latvia. Although the level of technological competitiveness of Ukraine in 2016-2018 increased by 1.16%, in the ranking of the EU economy, Ukraine occupies the last positions, approaching the level of Romania. It is noteworthy that Romania is showing an improvement in the values of the integral coefficient of technological competitiveness of the economy.

Figure 4: Average annual increases in the coefficients of technological competitiveness of the EU countries and Ukraine, 2016-2018
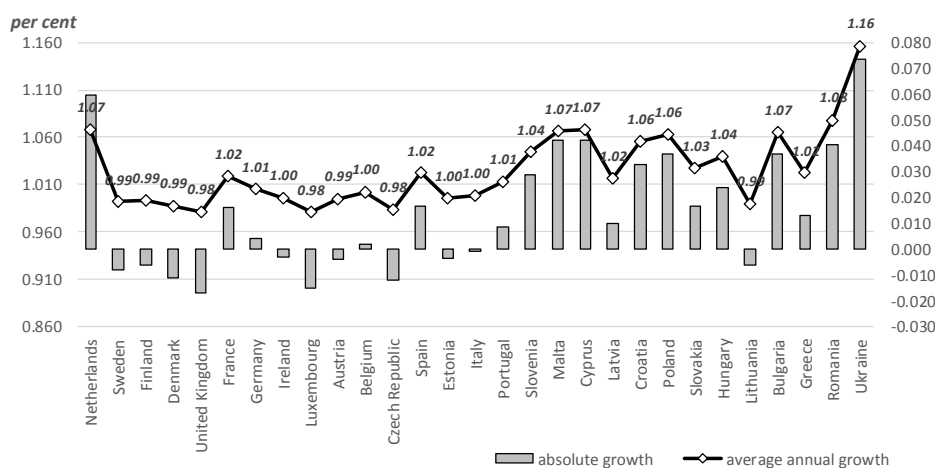
Source: authors' own complications based on the data of Figure 3

It should be stated that the value of the divergence of the levels of technological competitiveness of the EU-28 and Ukraine in 2016-2018 decreased by 0.042 (Figure 5). In 2018, the differentiation of values between Ukraine and the EU-28 was 0.179 (or about 18%). The average annual divergence rate was 3.3%. Thus, in 2016 for the EU-28 the index was 0.69, in 2017 it increased to 0.701 (there was an increase by 0.011), in 2018 it increased to 0.721 (0.02 more than in 2017 and 0.031 more than in 2016).

Figure 5. Integral coefficients of technological competitiveness of the EU-28 and Ukraine, 2016-2018
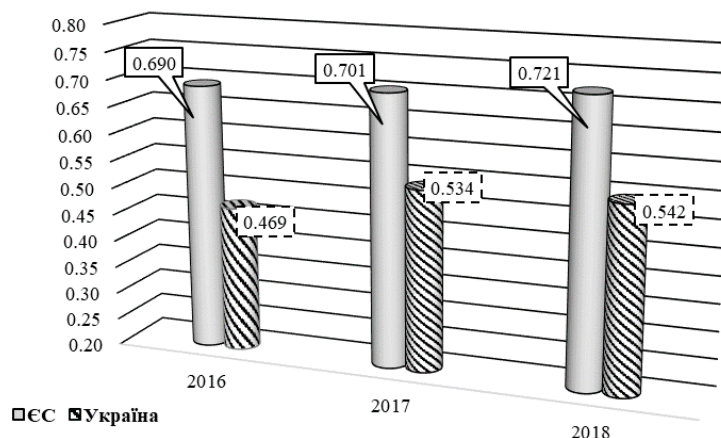
Source: authors' own complications by formula (2)

Thus, the level of technological competitiveness of Ukraine's economy is significantly low, which requires intensification of efforts to increase it. This can be achieved if Ukraine implements a state policy focused on the creation and implementation of advanced technologies, intensification of innovation, especially in the field of technological innovation, development of the intellectual sphere and implementation of its results in real production, development of innovation and technological infrastructure, improvement of the resource support of the technologization of the economy, formation of a favorable environment for strengthening the technological competitiveness of the national economy. It is also important to intensify Ukraine's cooperation in the high-tech sphere with the EU countries that are leaders in the level and pace of increasing the technological competitiveness of the economy.

In order to confirm the weak positions of technological competitiveness of Ukraine's economy, as well as to identify disparities between certain groups of EU countries, clustering of countries based on integral coefficients of technological competitiveness in 2016 and 2018 was done. Six groups of countries were identified according to the level of technological competitiveness of the economy. In 2016, none of the EU countries entered the cluster with Ukraine, and in 2018 – Greece (Table 3).

Table 3. Results of the cluster analysis of the grouping of the EU-28 countries and Ukraine according to the integral index of technological competitiveness of the economy, 2016-2018

Countries	Euclidean distances	Clusters, characteristics	Countries	Euclidean distances	Clusters, characteristics
2016					
Bulgaria	3.79		Cyprus	4.83	II, average
Greece	7.27		Malta	4.83	
Croatia	2.32	I, below average	Denmark	3.46	
Hungary	5.16		Netherlands	4.67	IV, the highest
Romania	4.04		Finland	3.55	
Slovakia	3.36		Sweden	4.89	
Czech Republic	4.94		United Kingdom	4.41	
Spain	5.70		Belgium	3.39	
Italy	5.06		Germany	3.76	
Latvia	5.36	III, above average	Estonia	6.00	
Lithuania	4.81		Ireland	5.16	VI, high
Poland	4.97		France	5.10	
Portugal	2.46		Luxembourg	7.55	
Slovenia	4.78		Austria	5.07	
Ukraine	0.00	V, low			
2018					
Greece	5.144317	I, low	Bulgaria	2.204495	
Ukraine	5.144317		Croatia	3.317951	
Czech Republic	4.317809		Hungary	5.030447	III, below average
Latvia	4.549740		Romania	3.527662	
Lithuania	3.797825		Slovakia	2.267951	
Poland	2.929870	II, above average	Italy	4.504861	
Portugal	3.117981		Cyprus	4.658517	V, average
Slovenia	3.689057		Malta	4.942582	
Denmark	4.265069		Belgium	3.875095	
Germany	4.447434		Estonia	4.622124	
Ireland	5.629371		Spain	4.906563	
Netherlands	5.039483		France	4.727511	
Finland	3.163581	IV, the highest	Luxembourg	7.608353	VI, high
Sweden	4.168157				
United Kingdom	4.464506		Austria	5.767816	

Source: authors' own complications based on the data of Figure 3 using Statistica 7 software

Therefore, in 2016 Denmark, the Netherlands, Finland, Sweden and the Great Britain formed the group of countries with the highest level of technological competitiveness. The second group, characterized by a high level of technological competitiveness, included Belgium, Germany, Estonia, Ireland, France, Luxembourg and Austria. Conventional outsiders among the countries on the criterion of technological competitiveness of the

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economy were Bulgaria, Greece, Croatia, Hungary, Romania and Slovakia, which are characterized by significant differentiation for EU countries on all indicators of technological competitiveness, especially in terms of innovation and technological development, the formation of technological infrastructure, digitization of the economy. Nevertheless, the level of technological competitiveness of Ukraine's economy was inferior even to these economies, which did not allow Ukraine to enter this group of countries.

The results of the analysis confirm the improvement of Ukraine's position on the technologization of Ukraine's economy, which together with Greece in 2018 formed a cluster of low level of technological competitiveness. In 2018, the highest level of technological competitiveness of the economy was characteristic for Denmark, Germany, Ireland, the Netherlands, Finland, Sweden and Great Britain. Belgium, Estonia, Spain, France, Luxembourg and Austria were also characterized by a high level of technological competitiveness of the economy.

It is necessary to pay attention to a number of countries whose level of technological competitiveness of economies is the lowest in the EU (Bulgaria, Croatia, Hungary, Romania and Slovakia). It is noteworthy that in 2016-2018, most countries maintained their positions; Germany and Ireland improved the level of technological competitiveness and moved from the group of high level of technological competitiveness to the group of countries with the highest level. Spain moved from the above average group to high one, and Italy moved from average to above average group.

Unfavourable trends in the field of innovation and technological development are typical for Greece. Thus, from the group of countries with a level of technological competitiveness of the economy below average, Greece in 2018 entered the cluster of low level.

Ukraine's low position in the ranking of countries by the level of development of innovative sectors of the economy, positive changes in technological activities, ensuring the technological competitiveness of the economy are due to objective and subjective, internal and external causes and factors. In particular, these are the instability of the economic, legal and political environment, and the general state of the economy, competitive environment and domestic market, underdevelopment and low capacity of infrastructure of innovation and research activities, low activity of business entities in terms of creation, commercialization and transfer of new technologies, as well as weakness of the financial and investment infrastructure in terms of supporting innovation and technology activities of the private sector.

4.2. Modeling and forecasting

A regression analysis was performed to confirm the thesis of the close connection between technological competitiveness and economic growth. Thus, a reverse connection was found between the intensification of research in the field of innovation, including human capital, and GDP per capita (formula 5).

$$GDP_t = \frac{7,665}{(4,707^*)} - \frac{4,539CAPIT_t}{(-4,449^*)} \quad , \qquad (5)$$
$$R^2 = 0,952 \quad DW = 2,98$$

It should be emphasized that the development of human capital and the improvement of labor market conditions should demonstrate a direct favorable connection with GDP. However, some factors to ensure the technological competitiveness of the country are inertial, characterized by lag dependence, some of them are characterized by critical growth limits, the achievement of which will have a destructive impact on the economic development of the country, including GDP.

Instead, other models demonstrate the favorable impact of the parameters of technological competitiveness of Ukraine's economy on GDP. In particular, with the improvement of innovation infrastructure and strengthening the ties of entities (by 1%) engaged in innovation and technology activities, with business representatives it can be expected GDP growth per capita in Ukraine by 1.39% and 1.9% respectively (formula 5-6).

$$GDP_t = \frac{-1,744}{(-1,286^*)} + \frac{1,387INFR_t}{(1,597^*)} \quad , \qquad (5)$$
$$R^2 = 0,718 \quad DW = 2,23$$

$$GDP_t = \begin{matrix} -2,478 \\ (-1,357^*) \end{matrix} + \begin{matrix} 1,903CONECT_t \\ (1,589^*) \end{matrix} , \qquad (6)$$
$$R^2 = 0,716 \quad DW = 2,22$$

It is remarkable that the increase in the values of the indicator of global knowledge leads to a significant increase in GDP per capita. This may mean that knowledge and innovation are closely linked to the country's technological development and thus attract investment in innovative sectors of the economy, which contributes to increasing the competitiveness of the economy and GDP growth (formula 7).

$$GDP_t = \begin{matrix} -1,522 \\ (-4,118^*) \end{matrix} + \begin{matrix} 1,296GLOBAL_t \\ (5,262^*) \end{matrix} , \qquad (7)$$
$$R^2 = 0,965 \quad DW = 2,09$$

It is important that the development of the digital economy sector of Ukraine, as evidenced by the variables of digital knowledge (formula 8) and technology (formula 9), contributes to an increase in GDP per capita.

$$GDP_t = \begin{matrix} -3,596 \\ (-1,591^*) \end{matrix} + \begin{matrix} 2,277KNOWL_t \\ (1,778^*) \end{matrix} , \qquad (7)$$
$$R^2 = 0,760 \quad DW = 2,31$$

$$GDP_t = \begin{matrix} -0,606 \\ (-2,997^*) \end{matrix} + \begin{matrix} 0,664TEHN_t \\ (5,091^*) \end{matrix} , \qquad (8)$$
$$R^2 = 0,963 \quad DW = 2,08$$

The indicator of high-tech export deserves special attention, which is an evidence of high technological competitiveness and innovation of the economy. The results of empirical calculations suggest that there is a close link between the share of high-tech exports and factors of economy technologization such as human capital and research, creative performance results, market and regulatory conditions in the labor market, global knowledge, technology and readiness for the future that are quite natural.

Thus, human capital and research, as well as the improvement of market and regulatory conditions in the labor market (formula 9-10) have a favorable impact on the growth of the share of high-tech exports (by 3.87 and 1.8%, respectively).

$$EXPORT_t = \begin{matrix} -5,383 \\ (-12,785^{**}) \end{matrix} + \begin{matrix} 3,873CAPIT_t \\ (14,677^{**}) \end{matrix} , \qquad (9)$$
$$R^2 = 0,995 \quad DW = 2,90$$

$$EXPORT_t = \begin{matrix} -2,122 \\ (-3,732^*) \end{matrix} + \begin{matrix} 1,803COND_t \\ (5,133^*) \end{matrix} , \qquad (10)$$
$$R^2 = 0,963 \quad DW = 2,15$$

Empirical assessments confirm the highest relevance of state policy aimed at preserving and developing human capital of Ukraine (especially in the context of global and large-scale attitudes of the majority of the population to external labor and further stationary migration), as well as creating a favourable environment to innovation and intellectual creativity. Only under such conditions it could be expected an increase in domestic exports, in particular high-tech and, accordingly, competitive one in foreign markets.

Instead, the level of favorable innovation environment in Ukraine is low. This is confirmed by the reverse relationship between the variables of creative activity results, global knowledge, technology and the share of domestic high-tech exports (Table 4).

Furthermore, there is an inverse link between the level of quality of life and the output of knowledge and technology, the ability of employers to attract talented people. In particular, with the increase in the value of human capital and research, market and regulatory conditions in the labor market and the ability of employers to attract gifted people by 1%, the quality of life in Ukraine becomes worse by 1.59%, 0.685% and 0.56%, respectively.

The results of modeling are additional evidence of the imperfection of the domestic environment of technological activity, as well as the low level of innovation and technological development and its impact on the indicators of social recovery in the country.

Instead, it was found that improving the use of knowledge and technology in business has a positive effect on the quality of life in Ukraine (correlation coefficient is 0.919, coefficient of determination is 0.743), which confirms the need to intensify state policy to support and

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stimulate the creation and implementation of new knowledge and technologies in business practice.

Table 4. The results of econometric modeling of the impact of indicators of technological competitiveness of the economy on the parameters of social and economic development of Ukraine

Impact on GDP

$$GDP_t = \begin{matrix} -1,522 \\ (-4,118^*) \end{matrix} + \begin{matrix} 1,296GLOBAL_t \\ (5,262^*) \end{matrix}$$
$$R^2 = 0,965 \quad DW = 2,09$$

$$GDP_t = \begin{matrix} 3,982 \\ (28,437^{**}) \end{matrix} - \begin{matrix} 2,200COND_t \\ (-25,429^{**}) \end{matrix}$$
$$R^2 = 0,929 \quad DW = 2,42$$

$$GDP_t = \begin{matrix} -2,366 \\ (-9,781^{**}) \end{matrix} + \begin{matrix} 1,764READY_t \\ (11,527^{**}) \end{matrix}$$
$$R^2 = 0,993 \quad DW = 2,92$$

$$GDP_t = \begin{matrix} -2,480 \\ (-3,094^*) \end{matrix} + \begin{matrix} 1,890RESUL_t \\ (3,620^*) \end{matrix}$$
$$R^2 = 0,929 \quad DW = 2,42$$

Impact on high technology exports

$$EXPORT_t = \begin{matrix} 3,087 \\ (2,996^*) \end{matrix} - \begin{matrix} 1,492RESUL_t \\ (-2,224^*) \end{matrix}$$
$$R^2 = 0,832 \quad DW = 2,52$$

$$EXPORT_t = \begin{matrix} 2,446 \\ (42,656^{**}) \end{matrix} - \begin{matrix} 1,099GLOBAL_t \\ (-28,783^{**}) \end{matrix}$$
$$R^2 = 0,998 \quad DW = 2,92$$

$$EXPORT_t = \begin{matrix} 1,618 \\ (5,435) \end{matrix} - \begin{matrix} 0,531TEHN_t \\ (-2,765^*) \end{matrix}$$
$$R^2 = 0,884 \quad DW = 2,80$$

$$EXPORT_t = \begin{matrix} 3,065 \\ (5,528^*) \end{matrix} - \begin{matrix} 1,435READY_t \\ (-4,093^*) \end{matrix}$$
$$R^2 = 0,944 \quad DW = 2,12$$

Influence on quality rating життя

$$INDEX_t = \begin{matrix} 4,500 \\ (7,550^{**}) \end{matrix} - \begin{matrix} 1,597CAPIT_t \\ (-4,275^*) \end{matrix}$$
$$R^2 = 0,948 \quad DW = 2,97$$

$$INDEX_t = \begin{matrix} 0,539 \\ (0,649) \end{matrix} + \begin{matrix} 0,919OUTPUT_t \\ (1,699^*) \end{matrix}$$
$$R^2 = 0,743 \quad DW = 1,83$$

$$INDEX_t = \begin{matrix} 3,060 \\ (5,174^*) \end{matrix} - \begin{matrix} 0,685COND_t \\ (-1,874^*) \end{matrix}$$
$$R^2 = 0,778 \quad DW = 2,58$$

$$INDEX_t = \begin{matrix} 2,831 \\ (9,298^{**}) \end{matrix} - \begin{matrix} 0,556ABILITY_t \\ (-2,887^*) \end{matrix}$$
$$R^2 = 0,893 \quad DW = 2,22$$

Source: authors' own complications using EViews 11 software

The favorable dependence of the quality of life on the factor of global knowledge (the corresponding regression coefficient is statistically significant at the level of 5%) can be interpreted in favor of the conclusion that the involvement of technology transfer, including knowledge, will promote the development of the social sphere (formula 11). The readiness of the country's economy for the future has a positive effect on the level of quality of life. A 1% increase in this indicator improves the level of quality of life by 0.54% (formula 12).

$$INDEX_t = \begin{matrix} 1,279 \\ (7,046^{**}) \end{matrix} + \begin{matrix} 0,449GLOBAL_t \\ (3,713^*) \end{matrix} \quad , \quad\quad (11)$$
$$R^2 = 0,932 \quad DW = 2,98$$

$$INDEX_t = \begin{matrix} 1,105 \\ (2,187^*) \end{matrix} + \begin{matrix} 0,536READY_t \\ (1,678^*) \end{matrix} \quad , \quad\quad (12)$$
$$R^2 = 0,738 \quad DW = 2,92$$

The key stage of modeling is to predict the impact of changes in the values of technological competitiveness indicators on the basic social and economic indicators of Ukraine's development, which aims to determine the expected results of effective state policy to strengthen technological competitiveness of Ukraine. Based on the modeling, it is possible to obtain hypothetical characteristics of social and economic development of Ukraine if the values of economic divergence of Ukraine decrease and a group of countries with a level of technological competitiveness is below average, average and above average. To confirm the

thesis, the forecasting of GDP per capita (formula 13) and the quality of life index (formula 14) are carried out.

$$GDP_t = (0.135^{**})^{\frac{3,333}{}} \cos(2CONECT_t) - (0.136^{**})^{\frac{3.426}{}} \sin(CONECT_t),$$ (13)
$$R^2 = 0.955 \quad AICC = -9.308$$

$$GDP_t = \frac{1}{(0.889^{**})^{\frac{3,163}{}} - (0.249^{**})^{\frac{0,787}{}} \ln(RESULT_t)},$$ (14)
$$R^2 = 0,929 \quad AICC = -7,927$$

Provided that Ukraine will be characterized by the value of the indicator of quality of business links and research sector in Slovakia that is a country that fell into the group below average level of technological competitiveness, the forecasting value of GDP per capita will be 3.45 thousand dollars, in Italy (group of countries with an average level of technological competitiveness) it will be 5.87 thousand dollars, in Czech Republic (above average) it will be 6.58 thousand dollars.

Modeling the situation that Ukraine receives the position of Slovakia on the indicator of results of creative activity, it is obtained the forecasting value of GDP per capita for 3.34 thousand dollars. If Ukraine reaches the values of the corresponding indicator of Cyprus (country with an average level of innovative development), the volume of GDP per capita may be about 4.60 thousand dollars, and when reaching the level of the Czech Republic (country with above average level of innovative development), it will be 5.42 thousand dollars.

The obtained model of dependence of GDP per capita on the indicator of the quality level of links between business and research sector for Ukraine is wavy (Figure 6). Thus, the highest values of GDP per capita in Ukraine can be achieved with the maximum growth of the performance of creative activity and the values of the quality of relations between business and research sector in the range of 30-32 and 34-36, respectively.

Figure 6: Visualization of the dependence of GDP per capita on individual indicators of technological competitiveness of Ukraine

a) quality level of links between business and research sector	b) effectiveness of creative activity
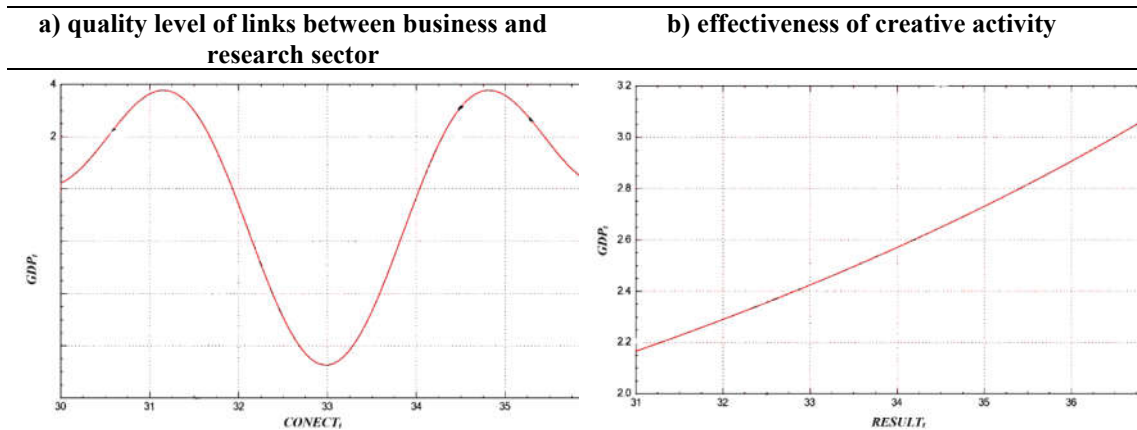
Source: authors' development, using CurveExpert Professional software

Based on the prognostic model of the quality of life index (formula 15), it is determined that if Ukraine achieves the values of the quality level of connections between business and research sector of Hungary, the quality of life will be 106.2, and when the values reach Cyprus and the Czech Republic, it will be 113,26 and 124,43, respectively.

$$INDEX_t = (\frac{1}{(0,005^{**})^{\frac{0,022}{}} - (0,000^{**})^{\frac{0,003}{}} OUTPUT_t}),$$ (15)
$$R^2 = 0,886 \quad AICC = 10,445$$

Empirical and prognostic assessments confirm the thesis (Table 5) that a higher level of quality of life in the country can be obtained because of improving cooperation between business and science, research, commercialization of research and technology transfer.

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Table 5. The results of forecasting the impact of individual indicators of technological competitiveness of the economy on the parameters of social and economic growth in Ukraine

Parameters	Actual values of indicators, 2018	Predicted values		
		Groups of countries by the level of technological competitiveness of the economy		
		below average	average	above average
GDP per capita, thousand dollars of USA	3.1	3.34-3.45	4.6-5.87	5.42-6.58
Quality of life index	95.96	106.2	113.26	124.43

Source: authors' own complications based on formulas (4-5) using CurveExpert Professional software

One of the priority tasks of Ukraine in line with strengthening the technological competitiveness of the economy is the search of new resources for economic growth and the formation of new types of economic relations in a systemic crisis. To create favorable conditions for the development of an innovative economy, Ukraine has to choose a new approach to the formation of the intellectual property market, as well as the use and commercialization of knowledge and innovation. The main difference between the latest tactics is that advanced technologies, innovations, know-how and knowledge become the intellectual reserve of the country and are the main resource of its development. One of the conditions for Ukraine's integration into the new economic system is the creating effective mechanisms for the use of intellectual resources, especially those covered by intellectual property rights.

5. **Discussion**

Ukraine's strategic priorities on the path to becoming its technologically capable economy lie in three following planes:
1) forming of a digital society based on knowledge and new technologies;
2) creating a digital state on the basis of e-government and e-inclusive democracy;
3) introducing digital business within the digital single market.

Such goals are declared in the national strategic documents, but are not supported by specific programs for their implementation. At the same time, sectoral digital modernization in Ukraine is reflected in key strategies and concepts for the development of basic sectors of the economy and spheres of public life (industry, energy, transport, agriculture, defence industry, trade, financial sector, ICT industry, social and humanitarian sphere).

The policy of intellectualization and digitization of Ukraine's economy in the focus of its structural and technological restructuring should take into account three development priorities that are intellectualization of the economy (smart specialization, creativity, formation of new knowledge); digitization of the economy and society (digital state, digital society, digital market); technological modernization of production as a factor in the formation of technological competitiveness.

One of the main conditions of technological development of the economy is the institutional infrastructure of innovation and technological activity. Lower level of development of its elements and their capacity in Ukraine in comparison with high-tech states is due, among other reasons, to disinterest and, accordingly, non-involvement in its development of all parties responsible for innovation and technological modernization of the country. The formation of a high-quality and effective institutional infrastructure of technological competitiveness of the Ukrainian economy requires the introduction of a new approach, namely the creating a collective contractual organizational and institutional system in this area, the sequence of its formation is presented in Figure 7.

It is a question of joint efforts, and delegation of functions and tasks between the state, associative business structures, associations of the organizations of education, science, innovations, and the organizations of civil society. Subjects of collective contractual regulation should distribute areas of responsibility for the main functions of the process development of technologization of the national economy such as organization of institutional infrastructure, information and communication, identification of institutional resource support, creating a bank of institutions to support innovation and technological activity,

innovation and technology mediation, incubation of start-ups, cooperation and introduction of high-tech products in the market.

Figure 7: Collective contractual organizational and institutional system to ensure technological competitiveness of the economy of Ukraine
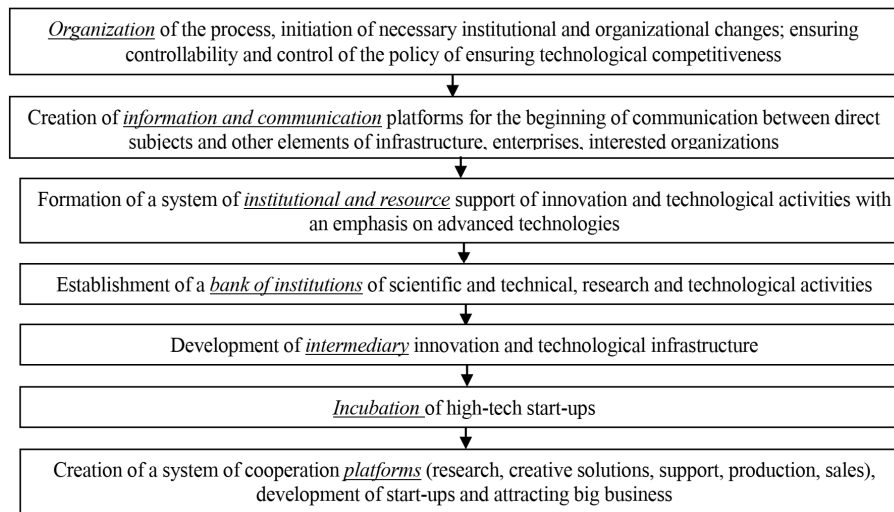
Source: authors' development

6. Conclusion

Poor links of the domestic technological system are the low level of development of the intellectual property market and the transfer system of modern advanced technologies. The task of formation and implementation of state policy tools aimed at improving these aspects of the technologization environment of the domestic economy has been actualized. It is necessary to implement in practice the developed authors' model, which defines institutions (innovation agencies, R&D centres, spinning organizations, scientific clusters, intellectual property centres, technology transfer centres, bridge organizations) and processes (industrial and scientific and technological cooperation, system of intermediaries of technology transfer and means of their interaction, processes of commercialization of intellectual property) that are absent or insufficiently functioning.

A significant impact of the processes of technologization of the economy was found on the basic parameters of social and economic development of the country. In particular, the following factors have a direct impact on GDP growth as human capital and research (regression coefficient – 0.418), as well as the links between the R&D sector and business (0.54); employers' ability to attract talented people (0.748), the ability of enterprises to retain qualified personnel (0.236) and the availability of prerequisites for career growth (0.41); digital knowledge (0.398), advanced technologies (0.18) and readiness to create and implement the technologies of the future (1.323). If the level of technological competitiveness of Ukraine's economy increases and it moves to groups of countries with higher integral values, GDP per capita will increase significantly, and the quality of life in the country will be also improved.

The competitiveness of the EU and Ukraine is determined by intellectual, information and communication, innovation and technological indicators, which, in turn, are closely correlated with each other and form the modern digital society. The implementation of sustainable digital development goals can be complicated by the lack of a clear strategic argument and tactical management of these processes. The expansion of tasks and functions in the field of managing the development of technological competitiveness of Ukraine's economy requires the institutionalization of a collective contractual organizational and institutional system with the participation of the state, public sector, business associations, and education, science and research institutions.

The system implementation algorithm includes the process organization, creating information and communication platforms, the formation of the system of institutional and

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resource support, creating a bank of scientific and technical and research and technological infrastructure institutions, the development of intermediary infrastructure, the incubation of high-tech start-ups, creating a system of cooperation platforms.

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TECHNOLOGICAL CHANGE, TECHNOLOGICAL CATCH-UP AND MARKET POTENTIAL: EVIDENCE FROM THE EU REGIONS

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Abstract

The paper examines the way(s) market potential affects the EU regions' technological change and technological catch-up. The analysis refers to a sample of 263 NUTS II EU regions and covers the period 1995-2008 (i.e. prior to the outburst of the economic crisis). On the basis of the latest advances of nonparametric frontier analysis, and in the presence of dynamic effects, time-dependent conditional nonparametric frontiers are developed. The incorporation of the dynamic effects of the EU regions' market potential conditions, allows for modelling the corresponding effects on technological change and technological catch-up. The findings of the paper provide valuable insight to both theory and policy-making, revealing that, within the integrated EU space, market potential acts as a technology-initiating factor, creating asymmetric effects and leaving a distinct "spatial footprint" with respect to the processes of technological change and technological catch-up.

Keywords: technological change, technological catch-up, market potential, EU regions, nonparametric frontier analysis

JEL classification: C14, O3, R11

1. Introduction

Technological change may summarize into the overall process of invention, innovation, and diffusion of technology (Rothwell 1994, Godin 2006). Technology itself, capturing the array of ideas, skills, techniques, methods, and practices that are used in the production process, defined as "knowledge about how to produce goods and services" (Fagerberg et al. 2014, p.316), is a cornerstone of industrial and post-industrial economies (Ball 1957, Arthur 2009). The general understanding of technological change as a progressive, accelerating and cumulative process (Freeman 1994, Ziman 2000, Mokyr 2002, Ho and Lee 2015, Wei and Liu 2019) supports the idea of technological catch-up (Nelson and Phelps 1966, Abramovitz 1986, Choung et al. 2012, Ahn, 2017) in the sense that technology diffuses by linking economies ever more intensively (Patel and Pavitt 1994, Blomström and Kokko 1998, Keller 2004). In the field of economics, technological change and technological catch-up are reflected in the change in the set of the feasible production possibilities i.e., in the combinations of inputs and outputs that comprise a technologically feasible way to produce (Coelli et al. 2005). Particularly, technological change is reflected in the shift of the production possibilities frontier and technological catch-up is reflected in the decrease of the distance from the production possibilities frontier. It thus comes that factors that initiate technological change and technological catch-up may spur economic growth by allowing

economic agents to produce more (and, presumptively, novel) output using fewer inputs (Solow 1957, Grossman and Helpman 1991, Aghion and Howitt 1992, Bresnahan and Trajtenberg 1995).

Technology creates externalities i.e., benefits and costs that are infeasible to charge to provide and not to provide, respectively (Pigou 1920/1932, Scitovsky 1954, Buchanan and Stubblebine 1962), so as the production function of a firm imposes positive and/or negative effects on the production functions of other firms. Despite the fact that geographical distance is thought to lose its significance, owing to the ongoing improvement of communication and transportation, technological externalities are imprinted in space, leaving a distinct "spatial footprint". As Ertur and Koch (2007) and Lu and Wang (2015) point out, spatial externalities are present in the processes of technological change and technological catch-up. Taking this into consideration, and given that, in the realm of the real world, firms – critical economic agents, especially within the knowledge economy (Teece 1996) – are not "isolated islands" (Waverman et al. 1997, p.322), it comes that the effect of technology-initiating factors may not, necessarily, bounded by administrative boundaries (Holl 2012). It comes, scrutinizing the literature, that it is the "non-delimited" concept / measure of market potential (Harris 1954) that may capture the spatial scope over which the effects of technology-initiating factors may take place. In this sense, market potential may become a technology-initiating factor itself. This is so as market potential may use as a proxy for market demand on the rationale that the volume of interactions among the economies considered (usually against the backdrop of their purchasing powers) is lower the further apart these economies are. As it relates to the "Law of Universal Gravitation" (Newton 1687/1846) (i.e., every point mass in the universe attracts every other point mass with a force that is directly proportional to the product of their masses and inversely proportional to the square distance between them), market potential is an intriguing concept and, as such, it has been used, extensively, in the empirical literature (Brülhart et al. 2004, Head and Mayer 2004 and 2006, Ottaviano and Pinelli 2006). This may, also, attribute to the fact that, within the new economic geography school, it has been provided with theoretical underpinnings (Fujita et al. 1999, Hanson 2005), thus receiving renewed interest.

The paper, following the latest advances of nonparametric frontier analysis, evaluates the patterns of the EU regions' technological change and technological catch-up subject to the corresponding market potential conditions, in the presence of dynamic effects. To this end, for the first time in the relative literature, at least to the best of knowledge, the paper applies the probabilistic approach of conditional nonparametric frontier analysis (Daraio and Simar 2005, 2007a and 2007b, Mastromarco and Simar 2015). The embodiment of time-dependent conditional nonparametric measures allows for such an evaluation to take place in the presence of dynamic effects. Studying a sample of 263 EU NUTS II regions, for the period 1995-2008 (i.e. prior to the outburst of the economic crisis), the paper provides clear-cut empirical evidence that market potential, actually, acts as a technology-initiating factor. Detecting a non-linear, and highly-influenced by its absolute level, effect of market potential on both technological change and technological catch-up, for specific groups of EU regions (i.e. Eastern, Western, Southern, Northern EU regions), the paper stresses out that, within the integrated EU space, market potential creates asymmetric effects and leaves a distinct "spatial footprint" with respect to the processes of technological change and technological catch-up.

The paper proceeds as follows: The next section provides a critical survey of the discussion in the literature concerning the spatial externalities that technology creates. The third section commends on the data and describes the methodological approach. The fourth section provides the findings of the empirical analysis. The last section offers the conclusions and some policy implications.

2.   <u>Technology and spatial externalities</u>

Mankiw et al. (1992, p.410) by providing a human-capital-augmented empirical specification of the neoclassical Solow-Swan growth model (Solow 1956, Swan 1956), assert that technology "reflects primarily the advancement of knowledge, which is not country-specific". As Denison (1967, p.282) argues, "because knowledge is an international commodity, I should expect the contribution of advances of knowledge … to be of about the

same size in all countries". On the other end of an imaginable theoretical spectrum, Arrow (1962), Romer (1986) and Lucas (1988) reject the treatment of technology as an exogenously-determined growth determinant (i.e. as a pure public good) postulating the exact opposite argument: technology is endogenously-determined as the outcome of cumulative experience (i.e. learning-by-doing) and, as such, is country-specific. Instead, learning (i.e. technological knowledge) is the pure public good: as the outcome of the country-wide experience it may apply at the firm-level. Nevertheless, even under such an assumption, technological catch-up is far from being an outright process (Griliches 1957, Basu and Weil 1998, Comin and Bart 2004) as technological knowledge is subject to distance-decay processes (Faggian and McCann 2006, Caragliu and Nijkamp 2016). This may consider as the aftereffect of the tacit (i.e. the non-codified) dimension of technological knowledge (Polanyi 1966, Nelson and Winter 1982, Nonaka and Takeuchi 1995). Tacit knowledge, which may condense into the informal exchange of ideas among firms does not travel easily since it is difficult to codify (Breschi and Lissoni 2001a). In this light, technological knowledge cannot be treated as a pure public good since the access of (tacit) knowledge is neither cost-free nor learning-free (Buchmann 2015). Thus, instead of easing technological catch-up, technological change may disclose the inability of the technologically less advanced economies to compete with their more advanced counterparts in the markets for knowledge-intensive activities (Camagni 1992, Cox and Wood 1997, Brülhart and Elliott 1998). This provides a clear-cut answer to questions such as "why do private firms perform basic research (with their own money)?" (Rosenberg 1990, p.165) and "why [an economy or a firm] should it not sit back and wait for technology diffusion that flows costlessly" (Benhabib and Spiegel 2005, p.937).

Focusing on knowledge spillovers, and, particularly, on tacit knowledge, Boschma (2005, pp. 62-68) stresses the argument that proximity besides geographical, is also cognitive (i.e. in the sense that "knowledge and innovations are often cumulative and localized outcomes of search processes within firms with a high degree of tacit knowledge"), organizational (i.e. in the sense that "knowledge creation […] depends on a capacity to coordinate the exchange of complementary pieces of knowledge owned by a variety of actors within and between organizations"), social (i.e. in the sense that "social ties or relations affect economic outcomes"), and institutional (i.e. in the sense that "the idea of economic actors sharing the same institutional rules of the game, as well as a set of cultural habits and values […] all provide a basis for economic coordination and interactive learning"). As Caragliu and Nijkamp (2016, p.754) indicate, "these forms of proximity complement the role of geographic distance as a factor which impedes the flow of knowledge". According to Rodriguez-Pose and Crescenzi (2008, p.377), "the reason behind the emergence of mountains in a flat world is, precisely, the interdependence of all the different types of proximity". In fact, reality is significantly far from clichés, such as the "end of geography" (O'Brien 1992) and the "death of distance" (Cairncross 1997), and the notions of "slipperiness" (Markusen 1996, Friedman 2005) or "flatness" (Friedman 2007), which are combined to suggest "tendencies towards an equalization of chances of economic development" (Cox 2008, 389) or the "transformation of the economic order into a liquefied space of flows" (Scott and Storper 2003, p.581), in general. As aptly put by Gertler (2003, p.79), "… it becomes apparent why geography now "matters" so much".

According to Winter (1988, p.171), a firm may describe as a "repository of productive knowledge". This stresses out the importance, for a firm, of having access to technological knowledge, and, especially, to tacit knowledge. Jaffe et al. (1993), Audretsch and Feldman (1996 and 2004), and Anselin et al. (1997) demonstrate that the spatial diffusion of tacit knowledge is not free, accentuating the importance of localized knowledge spillovers. On these grounds, Fujita and Thisse (2003) argue that agglomeration economies may lead to higher growth allowing for innovation to follow a fast(er) pace. Building on Marshall (1890) and Jacobs (1969), it comes that firms tend to cluster in order to enjoy the benefits of agglomeration economies (running, of course, the danger to encumber with negative effects, such as higher land rent and heavier congestion) in the sense of specialization (localization economies) and/or diversification (urbanization economies) (Glaeser et al. 1992, Henderson et al. 1995, Quigley 1998, Duranton and Puga 2001, Parr 2002). The so-called "third Italy" (Brusco 1982) as well as concepts such as the "innovative milieu" (Aydalot 1986, Camagni 1991) and the "business clusters" (Porter 1990) is a reminder that firms tend, indeed, to locate

in close proximity to each other, forming clusters (Martin and Sunley 2003). Aside from labor market pooling and input sharing, agglomeration economies facilitate, with respect to technology, knowledge spillovers i.e., the transmission of (technological) knowledge among firms. As Audretsch et al. (2007) and Karagiannis (2007) point out, knowledge spillovers have been gaining paramount importance as efficiency-improving factor, especially as the markets for standardized products started to saturate.

Facilitating the creation of knowledge capital, through the diffusion of knowledge spillovers, the clustering of firms has, accordingly, been gaining paramount importance as well. This is so as, within clusters, technological knowledge becomes a local public good (Maskell and Malmberg 1999, Breschi and Lissoni 2001b, Crespo et al. 2014). Yet, not all clusters are equally successful as agglomeration economies exhibit an uneven impact. Asheim and Isaksen (2002) support that the extra-cluster knowledge exchange is the decisive factor for such an unevenness. As Cantwell and Iammarino (2003) point out, it is the formation of extra-cluster linkages that prevents a firm from being locked-in a cluster of firms that follow a mediocre technological path. As Essletzbichler and Rigby (2005 and 2006) demonstrated, trajectories of technological change suggest that heterogeneity in production techniques is a permanent feature of an economy, manifesting in the regional (i.e. intra-cluster) accumulation of technological knowledge. According to Rychen and Zimmermann (2008) and Crespo et al. (2014), the ability of regions to host networks of interacting firms is a key factor explaining regional performance differences. Hence, the formation of extra-cluster linkages may, essentially, translate as embeddedness in the global value chains, and as such it raises the variety of the knowledge ingredients of knowledge capital (Uzzi 1997). As Zhou et al. (2011) stress out, not only endogenous networks but also external agents, as well as the interaction between internal and external agents (Bathelt et al. 2004), are critical parameters as regards technological change and the production of technological trajectories. Thus, in line with Marques (2015), bringing mechanisms that encourage firms' inter-cluster interaction are necessary. Of course, access to a network of firms is not costless (Rosenberg 1990) and, apparently, differences in firm performance may, partly, explain with the heterogeneous levels of embeddedness within innovation networks (Granovetter 1985, Dosi and Nelson 2010, Buchmann and Pyka 2012). Hence, the discussion turns to the concept of market potential indicating that technology-intensive (and, in general, knowledge-intensive) firms tend (or aspire) to locate in territories that exhibit relatively high market potential so as to benefit from both the intra-cluster and the extra-cluster (technological) knowledge transfer. Yet, at this point, the question that comes forth is whether this is, also, the case within the integrated EU economic space - and especially at the regional level - at which technology barriers are, de facto, lean(er).

In the course of time, the EU has managed, in a series of enlargements, to expand, first southwards and then eastwards, integrating economies less and less (technologically) developed. The gradual "thinning" of (the artificial) border impediments is, precisely, the pure essence of the European (economic) integration process (Kallioras et al., 2009). The EU is, gradually, moving from "a space of States" to a "State of spaces" (Karanika and Kallioras, 2018), and, in this sense, within the integrated EU framework, the European territories have been experiencing a period of unprecedented change (Brülhart et al. 2004, Crescenzi et al. 2014). Particularly, the process of (economic) integration has, progressively, transformed spatial economies (i.e. regional economies, in particular) into integral parts of the emerging European (economic) space (Petrakos et al. 2005 and 2011). Yet, the latter, instead of getting "flat", is getting more "curved", as it appears to be, simultaneously, characterized - in analogy with the terminology used by McCann (2008) - both by European "flattening" and local "steepening", and thus more "sticky". Such "stickiness" may even reinforce spatial externalities (Kemeny 2011). This is so as although economic integration has greatly enhanced the mobility of people, products, and production factors – and money – this has "neither implied the ubiquity of economic activity nor undermined the need for urban concentration" (Scott et al. 2001, p.15). In contrast, technological change – a main force "behind perpetually rising standards of living" (Grossman and Helpman 1994, p.24) – becomes endogenous and changes "differently in different territories" (Rodríguez-Pose and Crescenzi 2008, p.378). The EU reality indicates, indeed, that the core EU regions generate advantages leading to differential growth performance operating as hubs for knowledge-

intensive economic activities (Melachroinos 2002, Kallioras and Petrakos 2010, Petrakos et al. 2012).

3. **Data and methodology**

3.1. **Data description**

The paper utilizes employment, GVA, and capital stock data obtained from European Regional Database (Cambridge Econometrics). Employment is expressed in number of employees, whereas GVA and capital stock are expressed in € (in constant, year 2000, prices). The analysis refers to a sample of 263 NUTS II EU regions and covers the period 1995-2008; 1995 is the first year with available EU-wide regional data (note: Croatia is not included in the analysis) and 2008 is the year prior to the outburst of the world-wide economic crisis.

For the needs of the empirical analysis, the paper compiles a Harris-type (Harris 1954) market potential measure, which is expressed under the formula:

$$MP_i = \sum_{j=1}^{n} \frac{GVA_i \, GVA_j}{d_{ij}} \tag{1}$$

where i denotes the corresponding region, j denotes each of the other regions considered (i.e. $j = 1, 2, 3, \ldots, n = 262$), MP_i stands for the market potential of region i, GVA_i stands for the GVA of region i, GVA_j stands for the GVA of regions j, d_{ij} stands for the distance (i.e., Euclidean distance) between (i.e. between the centroids) of regions i and j. Essentially, market potential is a measure that may introduce as a proxy for both agglomeration and accessibility (Martín-Barroso et al. 2015). Thus, Equation (1) may use as a demand-for-technology index that allows for the detection of the (potential) effects of proximity in the sense of market potential (Duvivier 2013) under the central place theory perspective that larger regions (i.e. regions with larger market potential) serve many of the same functions as smaller regions (i.e. regions with smaller market potential) plus higher-order functions not found in smaller regions (Colwell 1982). Particularly, under conditions of imperfect competition, Equation (1) allows for the detection of the effects of market potential on the time-evolving processes of technological change and technological catch-up.

In order to avoid aggregated generalizations, which may provide misleading results, the empirical analysis of the paper is performed separately for specific groups of the EU regions. Particularly, the EU regions under consideration are classified as Eastern, Western, Southern, and Northern EU regions, according to the corresponding classification of the EU countries suggested by the UN (2012). Particularly, the group of the Eastern EU regions comprises of regions that belong to Bulgaria, Czech Rep., Hungary, Poland, Romania, and Slovakia; the group of the Western EU regions comprises of regions that belong to Austria, Belgium, France, Germany, Luxemburg, and the Netherlands; the group of the Southern EU regions comprises of regions that belong to Greece, Italy, Malta, Portugal, Slovenia, and Spain; and the group of the Northern EU regions comprises of regions that belong to Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, Sweden, and the UK.

Tables 1a – 1d present the mean values for each of the variables considered, for each regional group, at a yearly basis, over the period 1995-2008. It comes that, by and large, the mean values of all variables considered are getting increased over time as regards the groups of the Western, the Southern, and the Northern EU regions. The same stands for market potential. The group of the Eastern EU regions provides a notable exception as regards the evolution of employment. Particularly, employment exhibits a decreasing trend over the period 1996-2002 as regards the Eastern EU regions, indicating the upsets of the period of transition (Kallioras and Petrakos 2010).

Table 1a. Mean values of the variables considered, period 1995-2008, Eastern EU regions

Eastern EU regions	Employment (employees)	Capital Stock (bn. €; constant, 2000, prices)	GVA (bn. €; constant, 2000, prices)	Market Potential (bn. bn. €; constant, 2000, prices)/km
1995	841,800	27,032	6,482	5,708
1996	849,433	27,794	6,759	6,079
1997	846,958	28,622	6,954	6,432
1998	827,103	29,519	7,139	6,789
1999	815,768	30,384	7,339	7,190
2000	813,539	31,239	7,660	7,789
2001	794,145	32,006	7,835	8,086
2002	764,225	32,716	8,051	8,390
2003	762,902	33,379	8,395	8,847
2004	764,539	34,091	8,847	9,544
2005	771,253	34,876	9,242	10,177
2006	787,380	35,801	9,826	11,180
2007	806,922	36,984	10,388	12,134
2008	822,270	38,244	10,837	12,766

Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

Table1b: Mean values of the variables considered, period 1995-2008, Western EU regions

Western EU regions	Employment (employees)	Capital Stock (bn. €; constant, 2000, prices)	GVA (bn. €; constant, 2000, prices)	Market Potential (bn. bn. €; constant, 2000, prices)/km
1995	752,280	123,669	41,076	69,334
1996	784,281	129,048	41,617	71,416
1997	788,240	134,291	42,573	74,886
1998	799,411	139,673	43,747	78,978
1999	812,869	145,259	44,988	83,542
2000	829,911	150,897	46,602	89,617
2001	835,786	156,075	47,268	92,247
2002	834,852	160,476	47,506	93,381
2003	829,890	164,601	47,683	94,369
2004	832,463	168,506	48,587	98,126
2005	835,103	172,302	49,300	101,133
2006	843,213	176,297	50,690	106,980
2007	857,146	180,459	52,009	112,477
2008	867,314	184,456	52,584	114,886

Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

Table 1c: Mean values of the variables considered, period 1995-2008, Southern EU regions

Southern EU regions	Employment (employees)	Capital Stock (bn. €; constant, 2000, prices)	GVA (bn. €; constant, 2000, prices)	Market Potential (bn. bn. €; constant, 2000, prices)/km
1995	734,946	89,021	29,691	27,418
1996	740,612	92,708	30,200	28,339
1997	749,730	96,402	31,017	29,760
1998	766,326	100,320	31,828	31,270
1999	780,147	104,432	32,701	32,926
2000	800,311	108,719	34,060	35,614
2001	817,567	112,978	34,929	37,143
2002	832,814	117,208	35,408	37,933
2003	848,547	121,286	35,866	38,707
2004	861,232	125,320	36,717	40,440
2005	876,569	129,267	37,382	41,774
2006	898,723	133,329	38,374	44,032
2007	915,007	137,360	38,435	45,031
2008	915,091	140,688	38,294	45,205

Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

3.2. Methodology

The paper assumes that regions' production processes satisfy the properties of no free lunch, free disposability, and bounded, closed, and convex set, following the economic

axioms specified by Shephard (1970). On this basis, the paper applies the probabilistic approach of conditional nonparametric frontier analysis, introduced, as extension of the work by Cazals et al. (2002), by Daraio and Simar (2005, 2007a and 2007b), which characterizes regions' production processes in the presence of the corresponding market potential levels. By using a dynamic framework, the paper allows for the insertion of the time dimension into the empirical analysis.

Let $X \in \mathfrak{R}_+^p$ and $Y \in R_+^q$ be the input and output vectors, respectively. Let, also, $Z \in R^d$ to denote the environmental (i.e. the exogenous to regions' production processes) variables (i.e., the regions' market potential levels). Then, the regions' unconditional attainable set (i.e. the set which is influenced by the regions' market potential levels) can be presented as the feasible combinations of regions' capital stock, employment and GVA like:

$$P = \left\{ (x,y) \in \mathfrak{R}_+^{p+q} \middle| x \text{ can produce } y \right. \tag{2}$$

and can be characterized as:

$$P = \left\{ (x,y) \middle| H_{X,Y}(x,y) > 0 \right\}, \tag{3}$$

where $H_{X,Y}(x,y) = \mathrm{Prob}(X \le x, Y \ge y)$. Then, the output-oriented Farrell-Debreu technical efficiency (Debreu 1951, Farrell 1957) of regions' production process (x,y) may define as:

$$\lambda(x,y) = \sup\left\{ \lambda \middle| (x, \lambda y) \in P \right\} = \sup\left\{ \lambda \middle| S_{Y|X}(\lambda y|x) > 0 \right. \tag{4}$$

Let time T is the extra-conditioning variable for every period t in the analysis, defining the attainable set $P_t^z \subset R_+^{p+q}$ as:

$$H_{X,Y|Z}^t(x,y|z) = \mathrm{Prob}(X \le x, Y \ge y|Z = z, T = t \tag{5}$$

Accordingly, Equation (4) can be described as:

$$\lambda_t(x,y|z) = \sup\left\{ \lambda \middle| (x, \lambda y) \in P_t^z \right\} = \sup\left\{ \lambda \middle| S_{Y|X,Z}^t(\lambda y|x,z) > 0 \right\} \tag{6}$$

Equation (6) describes the output-oriented efficiency measure of regions' production processes at time t, facing the corresponding effect of market potential levels.

The unconditional and conditional efficiency measures, presented in Equations (4) and (6), respectively, enable the evaluation of the effect of time and market potential on regions' technological change (i.e. on the shift of the frontier) and, applying unconditional and conditional order-α quantile efficiency measures (Daouia and Simar 2007), on regions' technological catch-up levels (i.e., on the distribution of their efficiencies). This is so as, according to Kumbhakar and Lovell (2000) and Bădin et al. (2012), when the exogenous factors affect technological factors, the outcome is the shift of the frontier, and when they, correspondingly, affect the efficiency levels (i.e., the distribution of efficiency) the outcome is the movement towards to and away from the frontier. These partial (or robust) efficiency measures for any $\alpha \in (0,1)$ can be defined for the unconditional and conditional case as:

$$\lambda_\alpha(x,y) = \sup\left\{ \lambda \middle| S_{Y|X}(\lambda y|x) > 1 - \alpha \right\} \tag{7}$$

and

$$\lambda_{t,\alpha}\left(x,y|z\right) = \sup\left\{\lambda \,\middle|\, S_{Y|X}^{t}\left(\lambda y|x,z\right) > 1-\alpha\right\} \tag{8}$$

Following Bădin et al. (2012) the paper applies a median value α (i.e. $\alpha = 0.5$) and calculates all the unconditional and conditional estimators by the Data Envelopment Analysis (DEA) mathematical programming approach (Daraio and Simar, 2005; 2007a; 2007b, Bădin et al. 2010; 2012). DEA is a non-parametric technique that has the advantage of avoiding misspecification problems regarding the characterization of regions' production processes. As a next step, the paper constructs ratios in order to investigate the effects of time and market potential on boundary (i.e., the shift of the frontier; technological change) and on distance (i.e., the distribution of efficiency; technological catch-up):

$$Q = \frac{\lambda_t(x,y|z)}{\lambda(x,y)} \tag{9}$$

and

$$Q_\alpha = \frac{\lambda_{\alpha,t}(x,y|z)}{\lambda_\alpha(x,y)} \tag{10}$$

For the purpose of the analysis, the paper uses nonparametric estimators of the efficiency scores in order to explore the effect of time and market potential, and it does so by perceiving the behavior of $\hat{Q}$ and $\hat{Q}_\alpha$ as a function of time and market potential. Particularly, the paper uses a local linear estimator (Jeong et al. 2010) and the Least Squares Cross Validation (LSCV) approach (Hall et al. 2004) for bandwidth selection. It comes that a tendency of the ratios to increase with time and market potential levels indicates a favorable effect on regions' technological change and catch-up. In the opposite case, it indicates an unfavorable effect. In the case where the effect is similar for both the full ($\hat{Q}$) and the robust ($\hat{Q}_\alpha$) frontiers, it may conclude that there is a shift on regions' frontier, while the distribution of regions' efficiencies remains the same, by accounting for the effect of time and regions' market potential levels. In any case, it has to be stressed out that the fully non-parametric methodological framework adopted allows for the drastic reduction of possible endogeneity problems (Frölich 2007 and 2008).

Table 1d: Mean values of the variables considered, period 1995-2008, Northern EU regions

Northern EU regions	Employment (employees)	Capital Stock (bn. €; constant, 2000, prices)	GVA (bn. €; constant, 2000, prices)	Market Potential (bn. bn. €; constant, 2000, prices)/km
1995	677,192	81,729	32,027	75,850
1996	681,946	84,957	32,972	81,149
1997	693,888	88,373	34,199	87,747
1998	701,135	92,291	35,511	95,986
1999	709,945	96,193	36,865	104,649
2000	719,806	100,084	38,438	113,391
2001	728,735	103,834	39,356	118,056
2002	733,932	107,471	40,239	123,409
2003	739,080	110,947	41,293	129,765
2004	744,433	114,512	42,541	137,483
2005	754,318	118,157	43,724	144,355
2006	765,060	122,046	45,161	153,216
2007	775,438	126,210	46,482	163,911
2008	780,453	129,657	46,797	166,565

Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

4. Empirical results

The efficiency estimates assume variable returns to scale (VRS) (Banker et al. 1984) in order to account for regions' different market potential. As has been indicated by Daraio and Simar (2007a), robust methods have two main advantages: firstly, they do not envelop all data points and, for that reason, are not influenced by extreme values; secondly, they do not suffer

from the "curse of dimensionality" compared to the DEA efficiency estimators. The order-α frontiers are not bounded by 1.000 as the DEA frontiers. Therefore, the higher the order-α estimated efficiency scores the higher the regions' productive efficiency levels. In contrast, the VRS frontiers are bounded by 1.000, which indicates the productive efficient regions, whereas values less than 1.000 indicate productive inefficient regions. The productive efficiency score of a region indicates its ability to maximize its GVA levels relative to the other regions, given its employment and capital stock levels.

Figures 1A and 1B present the diachronic evolution of the EU regional groups mean productive efficiency estimates (i.e. scores) from the VRS frontiers. It comes that the EU regions with the highest productive efficiency levels are mainly regions from Northern Europe, whereas regions mainly from Eastern Europe are having the lowest productive efficiency levels. It, also, comes that, under the assumption of VRS, the Southern and the Western EU regions have similar productive efficiency levels, presenting constantly decreasing trends. The Eastern EU regions exhibit increasing trends in the second half of the period under consideration, even managing to outperform the Southern EU regions. The Northern EU regions exhibit the highest productive efficiency levels, despite the fact that they present a constantly decreasing trend. The standard deviation of the estimated efficiency levels is decreasing over the years for the majority of the EU regions except for the Eastern ones. It is evident that the efficiency standard deviation values are increasing as regards the Eastern EU regions (especially after 2000), suggesting an uneven pattern of production efficiency levels. Such a phenomenon can be attributed to the decisive role of structural and geographical conditions in identifying the relative winners of the market-driven economic integration process (Kallioras and Petrakos 2010).

Figure 1a. Diachronic representation of mean efficiency scores, VRS efficiency scores, period 1995-2008
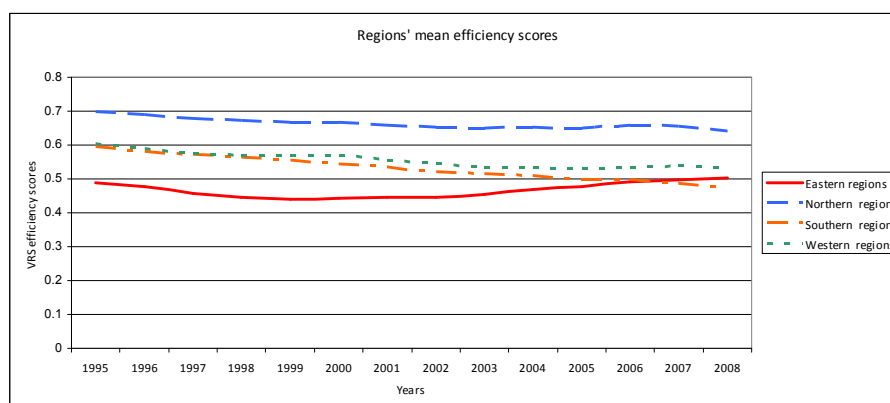
Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

Figure 1b. Diachronic representation of standard deviation of the VRS efficiency scores, period 1995-2008
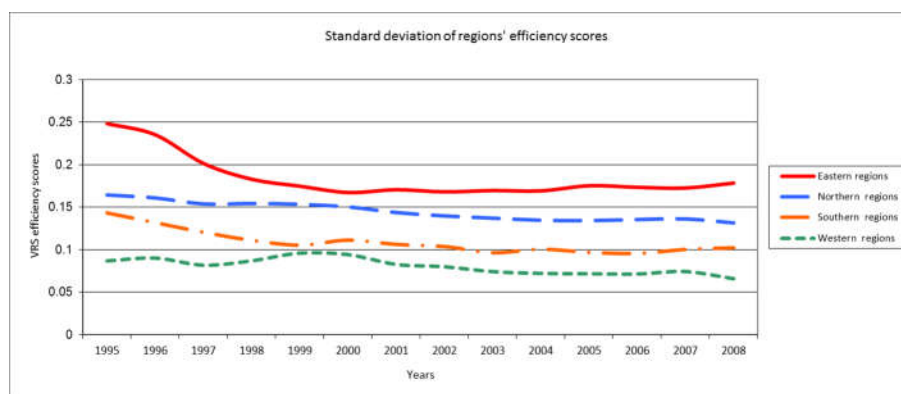
Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

Figures 2a – 2d and Figures 3a – 3d present, providing a combined 3-dimensional view, the effect of time and market potential on EU regional groups' technological change and

technological catch-up, respectively. The effect of time on both technological change and technological catch-up is getting increased, either in a linear or in a non-linear fashion, as regards the Western, the Southern and the Northern EU regions. In contrast, as regards the Eastern EU regions the effect of time on both technological change and technological catch-up is initially getting decreased and then becomes neutral and is getting increased, respectively. The effect of market potential on both technological change and technological catch-up is non-linear. Particularly, as regards the Eastern EU regions the effect of market potential on both technological change and technological catch-up is initially getting decreased and then is getting increased. As regards the Western EU regions, the effect of market potential on technological change is initially getting decreased, then is getting increased and then is getting decreased. The corresponding effect on technological catch-up is initially getting increased, then is getting decreased, then is getting increased again, and finally is getting decreased again. Concerning the Southern EU regions, the effect of market potential on technological change is initially getting decreased, then is getting increased and then is getting decreased. The corresponding effect on technological catch-up is initially getting increased and then is getting decreased. As regards the Northern EU regions, the effect of market potential on both technological change and technological catch-up is initially getting increased, then is getting decreased and then is getting increased.

Figures 2a-2d . The effect of market potential and time on regions' technological change, period 1995-2008

Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

Figures 3a-3d. The effect of market potential and time on regions' technological catch-up, period 1995-2008

The effect on regions' technological catch up-distribution of efficiency (Eastern regions)

The effect on regions' technological catch up-distribution of efficiency (Western regions)
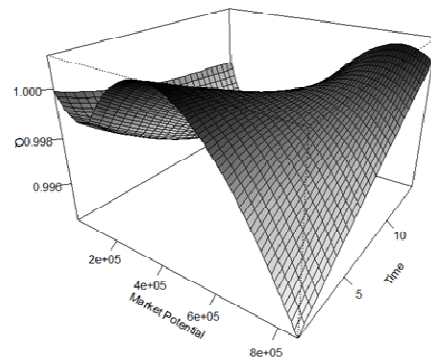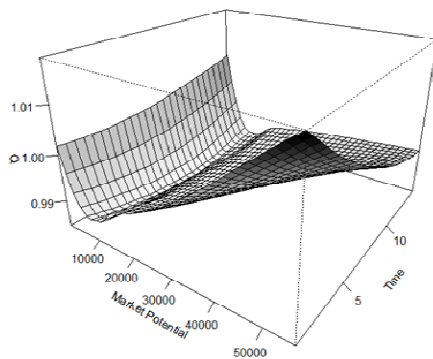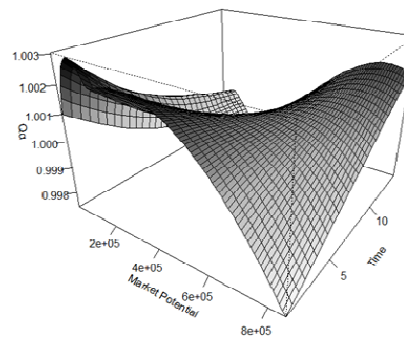
The effect on regions' technological catch up-distribution of efficiency (Southern regions)
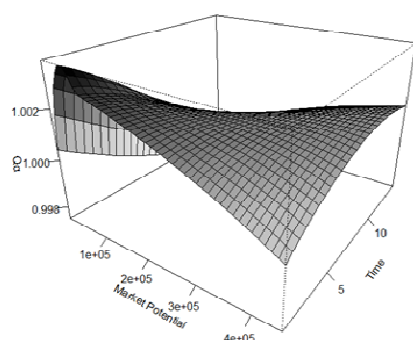
The effect on regions' technological catch up-distribution of efficiency (Northern regions)
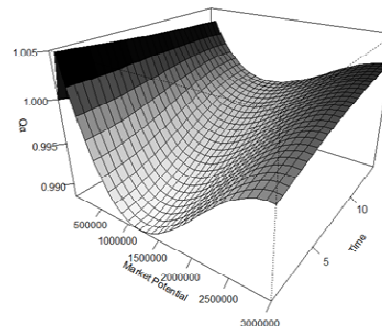
Sources: European Regional Database (Cambridge Econometrics) / Authors' elaboration

In absolute levels, it comes that the Northern EU regions exhibit the highest levels of market potential (i.e., ranging between 0 and 3,000,000 units approx.), followed by the Western EU regions (i.e., with market potential ranging between 0 and 800,000 units approx.), the Southern EU regions (i.e., with market potential ranging between 0 and 400,000 units approx.), and the Eastern EU regions (i.e., with market potential ranging between 0 and 50,000 units approx.). This is an absolutely justifiable result, given that "North-South" and the "West-East" dichotomies that characterize regional inequality in the EU in terms of GVA (Barrios and Strobl 2005, Petrakos et al. 2011). Under a macroscopic perspective, it comes that the effect of market potential on technological change and technological catch-up is highly influenced by its level. The juxtaposition of the results, for each particular regional group, reveals that the effect of market potential on technological change and technological catch-up follows a "mirror-image inclined N-shaped pattern". Figure 4 provides a conceptual visualization of the "mirror-image inclined N-shaped pattern" that governs the relationships between market potential and technological change as well as between market potential and technological catch-up. Apparently, the tendency that characterizes the relationships for the Eastern, the Southern and the Western EU regions matches, in an imaginary superposition, with the first, the second, and the third part, respectively, of the tendency that characterizes the relationships for the Northern EU regions. Thus, it comes that the effect of market potential on technological change and technological catch-up may increase either in very low levels of market potential or, most prominently, in very high levels of market potential.

Figure 4. The "mirror-image inclined N-shaped pattern" between market potential and technological change and technological catch-up
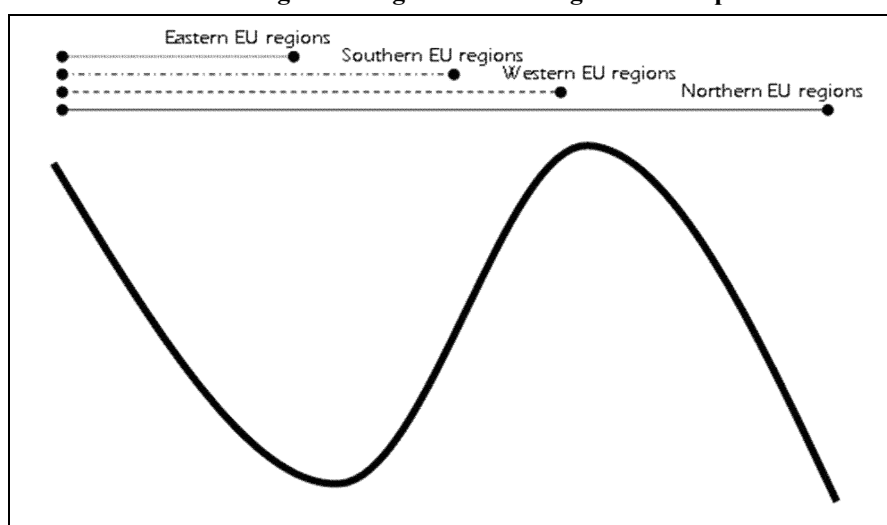
Sources: Authors' elaboration

5. Conclusions and policy implications

The paper applies the probabilistic approach of time-dependent conditional nonparametric frontier analysis and evaluates the patterns of the EU regions' technological change and technological catch-up subject to the corresponding market potential conditions, in the presence of dynamic effects. As time proves to have an increasing effect on both technological change and technological catch-up, for the entire sample of the EU regions under consideration (with the exception of the Eastern EU regions, for the early period of the analysis), the results of the empirical analysis indicate that market potential acts as a technology-initiating factor. This is so as the effect of market potential on both technological change and technological catch-up is non-linear, for the entire sample of the EU regions under consideration, and highly influenced by its level. In fact, it comes that, within the integrated EU space, market potential creates asymmetric effects and leaves a distinct "spatial footprint". Particularly, the relationship between market potential and technological change as well as the relationship between market potential and technological catch-up follow, in an imaginary superposition, a "mirror-image inclined N-shaped pattern".

Such a finding provides important policy implications. It comes that the most prominent effect of market potential on technological change and technological catch-up may find on the Northern and the Western EU regions (i.e. the core EU regions). Exhibiting, on average, the highest levels of market potential, the Northern and the Western EU regions may operate as hubs for technology-intensive (and knowledge-intensive, in general) economic activities as they manage to enjoy the benefits of both intra-cluster and extra-cluster technological knowledge. The effect of market potential on technological change and technological catch-up is, in contrast, less prominent in the Southern and the Eastern EU regions (i.e. the peripheral EU regions). It comes that in order to reap the benefits of market potential, so as to spur their levels of technological change and technological catch-up, the Southern and the Eastern EU regions need to increase their level of embeddedness in the European value chains so as to increase the intensity of interactions with their technologically more advanced counterparts. To do so, they need to increase their learning ability so as to increase the variety of the products they produce. Otherwise, they run the danger to be locked-in a mediocre technological path.

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TOTAL QUALITY MANAGEMENT IN PUBLIC SECTOR, CASE STUDY: CUSTOMS SERVICE

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Abstract

This current article aims to investigate the questions that are related to the existence of the contexts of the New Public Management and the implementation of the principles of the Total Quality Management and, on the other hand, the quest of the choices that have to be adopted, investigating as a case study the Customs Service. In Greece, we could realize for the first time evidence of TQM in the L.2880/2001/FEK 9-3.09.2001 "Programme Politeia for the reform and modernization of the Public Management and other provisions". Later on, the L.3230/2004/FEK-44.02.2004 "Establishment of a system of management with the target of the measurement of the efficiency and other provisions" was voted. Since then, other provisions have been voted that regulate matters of implementation of the procedures of NPM and of TQM in the public sector. A perch is taken by the L.4336/2015/FEK94.24-08-2015, which states the basic strategic lines for the reform of the administrative structures and procedures, the streamline of the human resources and also the transparency, the accountability, as well as the prevalence of the electronic governance. The Customs, since the 1st of May 2017 belongs to the Independent Authority of Public Revenue (IAPR). It is shown as the characteristic example of the study for implementing the Total Quality Management and illustrates at the same time the weaknesses and the strengths.

Keywords: Total Quality Management, New Public Management, Customs, Organizational and Managerial Systems

JEL classification: M1, M15, M16, M19

1. Introduction

The administrative reforms that have begun to establish in the last decades of the 20th century in the developed countries, which have already advanced administrative systems, constituted a comparative model for Greece. According to the exemplars these countries, the New Public Management (NPM) has adopted, which has been implemented efficiently for years in the private sector. As part of the administrative reforms, the Independent Authority of Public Revenue (IAPR) has been created for the earnings and the management of the public revenues. The Customs Office, as a component of IAPR, imposes the NPM and the principles of the Total Quality Management, which is the object of this research. In this article, a theoretical approach is presented briefly and it is connected with the Customs Office. It is also presented the methodology, the statistic analysis and the outcome of this relevant research, as well as the conclusions and the formulation of proposals for future research. For start, the first chapter is the introduction, which introduces to the reader the meaning of this specific research and presents in short the structure of the article. In the second article is presented a retrospect of researches and studies that are related to the findings of the research. It is also presented the temporal approach of the Total Quality and the TQM, as well as its relationship with the NPM. This chapter continues with the presentation of the aim of this research, through the structures and the function of the Customs, under the management of IAPR. The

third chapter is referred to the subject of the research and the questions that are under research, as well as the sampling and the collection of data. In the fourth chapter the two groups of the research, the structure of the questionnaires and the method of the statistic analysis are presented. As research samples are referred the two groups from which, the first one is the Customs Officers (internal clients) and the other is the Customs Brokers, as Customs representatives of the traders (private and businessmen). The fifth chapter includes the conclusion of the answers of the two questionnaires, in relation to the condition of the Customs (and the public management as a consequence) and its relationship with the TQM. Finally, this chapter is completed with the formulation of proposals for the completion of the reform and for the future research.

2. Background literature revew

Several researches and studies over the last few decades focus on issues relating to the implementation of principles of TQM.

In view of the changes in the public sector of N. Zealand, this study (Boston, 2000), raises questions that result and refer to the systemic change throughout the world. Questions, such as the timeliness of results evaluation and systemic reforms in public management over the last few years, in countries, such as Britain, Australia and N. Zealand. The study focused on changes occurring in daily practice, such as remuneration in accordance with performance on a finalized basis, distinction between the policies and the operations of public services, decentralization of human resource (HR) functions.

In this study (Vinni, 2007) there is an ambiguity between objectives relating to service provision oriented towards customer care and accountability to the public. This ambiguity creates problems associated with the identification of objectives, performance measurement as well as behavioral changes. This highlights the importance of executives, at government or service level in order to fulfill their role and meet the standards to lead the employees to a structured management environment, such as Total Quality Management.

The study of (Persson&Goldkuhl, 2007) concludes that e-governance constitutes a multi-disciplinary field, where there is need for ongoing research and the findings of the study should be widely used in public management. It is also focused on the more intensive use of Information and Communication Technologies in public management promoting a common course for management system and ICT.

Following the restructuring of public administration in the United States, a ten-year plan under the title "Report of the National Performance Review- NPR" was drafted, influenced by concepts of New Public Management at that time., to facilitate the transition from bureaucracy to an efficient and effective system of public management. Ever since that time it is regularly updated. According to (Thompson&Thompson, 2000) in 2000 the report focused in changes in federal bureaucracy. In this context, it recorded an improvement in customer service, highlighted quality management and leadership, as well as rationalization in management, control, reviews of programmes and transformation of structures.

The findings of the research, which was carried out by Quality Scotland Foundation (Q.S.F.) among 200 leading organization in Scotland according to (Soltani, Meer, Gennard, &Williams, 2000), involve improvement of employees performance, customer service, active participation of employees and performance-based evaluation approach, which constitute the generally accepted elements of Total Quality Management in order to properly understand the meaning of performance evaluation. This evaluation approach is in the interest of both sides, the employees and the parties transacting with the organizations.

According to the aforementioned research carried out by QSF, customer service, is the second most important criterion, for the HR performance measurement according to the key principles of quality management. This is in line with open organization without restrictions, as of the 1980's, when strict adherence to the procedures, according to Vemberian approach, was the dominant principle.

According to this study (I. Prajogo & M.McDermott, 2005) organizational culture is regarded as a fundamental aspect of the process of Total Quality Management. In the future organizational culture shall constitute the driving force behind TQM and it is suggested as a reason for longitudinal study.

2.1. The role of TQM in public administration

The present review examines the implementation of principles of Total Quality Management (TQM) through processes of New Public Management (NPM) and other methodological tools in relation to the situation that has been established so far in the public sector.

Customs Office has been selected for the purpose of the present case study as a public service that matches the characteristics of a bureaucratic organization, as well as the ones relating to the implementation of TQM principles through the process of New Public Management.

The revised Strategic Plan 2107-2020 of IAPR (Independent Authority of Public Revenue – AADE), refers to values such as the ones of Justice, Impartiality, Accountability, Integrity, Meritocracy, Knowledge and continuous Improvement, which are essential to open governance (AADE/ revised strategic plan 2017-2020)

According to OECD's report (2005), principles of good governance, such as transparency, accountability, justice, equality, efficacy and effectiveness, standards of ethical conduct, constitute the foundations of open governance.

In Greece the extended role of open governance is degraded in comparison to other countries of OECD and the E. U., since pathologies and malfunctions are hard to eliminate (OECD, 2011)

According to Politt and Summa (1997), Dionysopoulou P., & Kouremadi M., (2017), the principles of New Public Management are based on functions of classic management (programming, organization, decision making, management-coordination and monitoring).

The implementation of principles of New Public Management in public management, requires the transformation of bureaucratic types that have been maintained in the public sector for decades (Sotirakou, T. and Zeppou, M. , 2016)

The organizational structure cannot be that of a Traditional Organization Pyramid that relies on strict hierarchy. The new organizational structure should be oriented towards synthesis, through processes that:

•   Expand and strengthen the role of employees promoting autonomy, team work and responsibility that will match the result.
•   Educational improvement in combination with the use of a constantly evolving technology for the employees, introduction of innovative actions and process changing.
•   Organizational orientation towards working groups with relative autonomy, responsibilities as well as efficiency and effectiveness indicators for each activity and expansion of this concept throughout the organization hierarchy.

After the end of the war and the reconstruction efforts, the Greek state gave priority to the reorganization of public management.

Over the last three decades of the 20th century the administrative reforms were not included into a general strategic plan, were not functionally linked to other sectors of economy and society, and most of the times they did not entail adequate resources or appropriate implementation mechanisms with few exceptions, such as ASEP (Supreme Council for Civil Personnel Selection), KEP (Citizens' Service Centres), etc.

In accordance with the provisions of Article 3, par.Γ5 of the Law No.4336/2015/Government Gazette 94/14-08-2015 under the title "A Modern State and public administration" the country is bound to (Memorandum of Understanding for a three-year programme of EMS (European Stability Mechanism) develop and establish an effective and renowned public administration which shall be based on:

•   The organization of simplified and operational structures.
•   Establishment of flexible and operational administrative procedures.
•   New Improved Human Resources System.
•   Establishment of a programming, evaluation, transparency and monitoring system.
•   Computerization of public management and free access to it (Maistros, P,, 2016, p. 12-13)

A research conducted in 2007(Renate E.Meyer etal., 2014) in public organizations in Austria and more specifically Wien (a city with long-standing administrative tradition, large number of workers and wider range of duties), among 271 self-evaluated senior executives about "bureaucrats and devoted public managers: institutional logic, professional identities and incentives for the provision of public services", indicated the following:

• 110 individuals (rate 40,1 %) were attached to bureaucratic administrative practices (Staaatsdiener)
• 33 individuals (rate 12,2%) supported a management approach (public managers)
• 69 individuals (rate 25,5 %) exhibited mixed features of the two previous versions.
• 59 individuals (rate 21,7 %) provided responses that did not match any of the abovementioned versions.

The research also indicated reform elements, such as quality improvement, measurement of effectiveness. Finally, the research indicated that, the desired organizational model is that of the traditional sector (Vemberian), although towards a reform direction (Renate E.Meyer etal.,2014).

Apart from the effective reform of the abovementioned structures and processes, the role of human resources and the potential motivation thereof, constitute another basic factor for the effective implementation of NPM.

• The two most important theoretical approaches (Dervitsiotis K, 2005, p. 101-109) regarding the identification and leverage of human needs are a) Maslow's and b) Hertzberg's hierarchy on needs. Maslow indicated that when an incentive given to the employees fully satisfies their needs, then it ceases to operate as an incentive. Therefore, the need of a highly paid employee operates as a greater incentive than the salary increase.
• According to Hertzberg, the factors that motivate the employees can be categorized into endogenous or internal and exogenous or external. Endogenous factors are mainly the ones with the higher impact on the efficiency of the employees and rely on the chief executives to implement the appropriate mixture regarding the kind of remuneration. The conventional remuneration system (connection between the remuneration and mainly the length of employment) resulted to the inefficiency of employment, since the length of employment cannot be regarded as the main incentive for modern working conditions. Therefore, it falls under the organization's management to introduce either individual, or group performance incentives or a combination of both.
• As far as it concerns the target-setting process, which involves the participation of employees in developing and achieving the objectives, it is facilitated by MBO (Management by Objectives), which records the effectiveness and efficiency of work (Bourantas D, 2015, p. 341-350).

In Greece this was established by Law 3230/2004, according to which "all public services (Central Services, legal entities, local authorities of first and second degree) adopt a management system with objectives for the efficient operation of the public sector, as well as the response of human resources to the new standards of Public Management. (Tsimpoukidou et.al., 2013)

In the field of Human Resources Management (Dervitsiotis K, 2005, p. 71-76), the contribution of managers and employees constitutes an essential priority for the effective implementation of Total Quality Management. As indicated, corporate objectives cannot be achieved without meeting the employees' needs. In this perspective the identification and fulfillment of modern employee needs by the management is important, in order to develop the appropriate incentives strategy.

The transition to a modern public management refers to modern structures, modern processes and collective effort by all parties involved on the basis of strategy.

The implementation of New Public Management processes and Total Quality Management principles, without constant update and communication of the new system to all relevant actors, does not promote its perspectives and hampers the development of a modern culture or

a new vision. Bourantas D., (2015, p. 568-571) regards Total Quality Management as an evolution of management after 1950 and describes various administrative approaches of management, including Total Quality Management as a "contemporary management trend" which arose out of necessity. This necessity involves the demands of employees, the demands of entrepreneurs within the framework of competitiveness as well as the consumers' demands for quality. Total Quality Management developed over the last few decades in an environment of new technologies, brain and knowledge storming, establishment of new forms of labor guided by the market mechanisms, determining a framework of activities, such as:

•   The development of a strategic and operational activity and vision according to the principles of New Public Management.
•   The planning of structures and processes based on this strategy.
•   The establishment of a remuneration and evaluation system on the basis of target setting in this sense.
•   The coexistence and training of employees and managers en esprit de corps
•   Targeted action of the organization's management for the formulation of a new code of ethics and the creation of a new vision.
•   Monitoring and evaluation of the new management system's efficiency and effectiveness using measurement indicators.

Historically, public management is structured around European standards. (Kriemadis TH and Christakis M, 2009, p. 105-109).

However, it may also benefit from the constant and uninterrupted implementation of methodological tools, such as benchmarking methodology, Common Assessment Framework (CAF), etc.

According to 5432479 Dionysopoulou P.& Matsouka P. (Sfakianaki E, 2015, p. 212) the implementation of a Common Assessment Framework entails several advantages , which mainly result from the opportunity of participation of all parties involved in decision making and implementation, by means of a creative communication between all the actors which enables the efficient utilization of resources with simultaneous improvement of the services quality.

The purpose of the present review is to outline the implementation of principles of Total Quality Management through the process of New Public Management at the Customs Office based on the strategic and operative planning thereof, therefore the means for the implementation thereof. It also attempts to set down the effectiveness thereof in service provision and the ability to use innovative and technological applications in order to provide certified services to the citizens and establish a new public service culture.

The methodological tool used consists of two questionnaires - one for the human resources of the customs office, representing the service providers and one for the transactors, representing the service receivers. The questions were related to the demographic data of the two population groups, on the one side and to their view on the operation of the customs office and the perspective of a service structured around the standards and principles of Total Quality Management, on the other.

Therefore, it focuses on the development of a total management model, within the framework of the management model implemented for several years in administratively developed countries and it is based on the introduction of management in the public sector in relation the implementation of principles of Total Quality Management.

This new management system coexists with and contradicts bureaucratic structures and processes and should highlight the need for new structures and processes. It will also contribute to the production of better-quality products and services for the transactors with least possible cost.

Finally, apart from setting down the progressive improvement of a public service, such as customs, this research aims at outlining the general conclusions to promote the adherence of public management to TQM principles.

2.2. The case of customs

Among the first institutions established in the former Hellenic state following the national revival in order to preserve territorial integrity and the state revenue for the operation of the state, were the regular (official, state) army, the Navy and the Customs Office.

The publication of a National Customs Code, an exemplary legislative text, that imposed customs procedures and contributed to the widespread adoption of commerce, constitutes a turning point in the history of Customs Office (Law 1165/1918-Government Gazette.59/21-03-1918).

Major turning-points as indicated on the webpage of AADE were also:

•   Acquisition of vessels for the persecution of smuggling in 1931.
•   Maastricht Treaty in 1993.
•   In 2009 the necessary plans were outlined for the operation of an e-Customs environment.
•   Activation of Customs Office within the framework of an upgraded operation of A.A.D.E. since 01-01-2017.

By Law No. 4389/2016/Government Gazette 94-27.05.16 the General Secretariat of Public Revenue was abolished and the Independent Authority of Public Revenue (A.A.D.E.) was established, according to the European and international standards for the independence of tax administration.

Ever since its establishment by Law N.4389/2016 "Establishment of an Independent Authority of Public Revenue", IAPR (AADE) staying true to the concept of flexible and efficient tax administration, AADE enjoys functional, administrative and financial autonomy and subjects only to parliamentary scrutiny (N.4389/2016- Government Gazette.94/A/27-05-2016).

It also enacts all those provisions regarding the organization and operation thereof, elaborates strategic and business plans and draws up accounting reports after the end of the year which are placed on its website (AADE/Assignment-responsibilities).

As indicated in the introductory note of IAPR Commander (the independent authority for the collection and management of tax and customs revenue) its position, activity και assignment should "… match the needs of the society and the market…" determining its role as a social organization, according to the principles of management (AADE/revised strategic plan 2017-2020).

Its long-term plan is determined by the adoption of 5 strategic objectives, which are based more specifically on action lines.

The 9th consecutive mid-term project-pillar of the Operational Plan 2017 presents the strategy of AADE for Human Resources Management.

It also elaborates on the recruitment, evaluation, and stuff development system as well as the remuneration and incentive policy, objectively through an Integrated Human Resources Management Information System. Providing a modern Human Resources Management System, it refers to the important role of human resources in the development that gradually confers a new quality and vision to it.

The present Human Resources Management system bears limitations regarding employee placement, removal, evaluation, progress (in relation to personal career motivation) reward processes. There are also restrictions regarding the acceptance and the establishment of team work on the basis of effectiveness and efficiency.

The Authority conducts benchmarking within the European framework, with tax and customs administrations of countries with advanced management systems and its aspirations are included in a program, which is based on four "pillars" and forms a new Human Resources Management System.

The present situation with the important improvements in the structure and the operation of the customs office consolidates among workers and transactors the view that the implementation of principles of TQM through processes of New Public Management shall introduce a new culture to the customs office. This will allow it to shape its vision at a national level, contributing to the reform of the public management and at an international

level within the framework of the European Union (E.E.) and the World Customs Organization (WCO).

3.   Methodology

For the purpose of the research two questionnaires were drawn up. One for the customs officers (internal clients) and one for the customs brokers (external clients) as customs representatives of the transactors (individuals and entrepreneurs)

The questions include demographic data and other information as introduction to the concept of Total Quality Management, the means for implementing it, and the process for the implementation of New Public Management in Customs Office. Non-implementation of other methodological tools such as Common Assessment Framework (CAF) in Customs, has given rise to questions referring to it highlighting its importance.

3.1. Sample Design and Data Collection

The questionnaire consists of Likert scale (5point scale), multiple choice questions.

The research was carried out at two major customs offices in the Attica basin, the customs office at Athens International Airport "El. Venizelos" and at A´ customs office of Piraeus, which bring together the largest number of employees and transactors in customs service nationwide. The questionnaires were handed out in person to the two research groups, consisting of 100 respondents each.

The sample of the customs officers was selected out of 2.073 customs officers (data 31-12-2017) as indicated (Operational Plan AAΔE 2018), i.e. a rate of 5% and the sample of customs representatives out of a total of 2.686 workers in this field (data 2014), i.e. a rate of 4%, as indicated in a report of the Center of Planning and Economy Research in 2015.

Both samples were selected using the method of simple random sampling with a 10% maximum ratio estimator error per sample at a significance level of 5% (Zafeiropoulos, K,, 2015, p. 153-160).

The research was carried out adhering to the principles of the Code of Conduct. Reliability regarding the respondent's answers was achieved by means of an introductory note in the questionnaires referring to the purpose of the present research and the subject of the study. Anonymity was maintained while completing the questionnaire in order to comply with the principle of confidentiality. The questionnaires and the cover letter were submitted to the Customs Office.

3.2. Results

The analysis of the questionnaire includes three subsections:

The first includes the descriptive analysis of the questions to the employees, as well as crosstabs of the employee's questions that correlate with each other using the Spearman Correlation Sig. coefficient (2-tailed), due to non-regular distributions.

In this subsection, the participation of women in a sample of 100 workers, with abstention rate of 9%, was 49% and of men 42%. Workers aged between (31-40 years old) represent 8% of the respondents, workers aged between (41-50 years old) 31%, workers aged between (51-60 years old) represent 36% and workers over 61 years old represent 16%. It is observed that aggregated rates of 52% of the workers are over fifty years old.

Sufficiently increased participation of college/high-school graduates at a rate of 23%, considerable participation of higher education graduates at a rate of 55%, satisfactory participation among holders of master degrees at a rate of 12% and participation among PhD holders at a rate of 1%, were observed in the same sample of participants.

In Table 1, a cumulative rate of 21,10% of the respondents (totally disagree 3,30% and disagree 17,80%) responded negatively to the question, a rate of 47,80% was neutral (neither agree / nor disagree) and a cumulative rate of 31,10% (agree 30 % and totally agree 1,10%) agreed. The increased neutrality rate indicates that about half of the participants were indecisive. The transition from the bureaucratic system to the new management system is in progress and the progressive conversion of this rate in favor of the complete and operational introduction and record of customs procedures constitutes a "challenge".

Table 1: Record of customs procedures to date at the customs office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TOTALLY DISAGREE	3	3,0	3,3	3,3
	DISAGREE	16	16,0	17,8	21,1
	NOT AGREE / NOT DISAGREE	43	43,0	47,8	68,9
	AGREE	27	27,0	30,0	98,9
	TOTALLY AGREE	1	1,0	1,1	100,0
	Total	90	90,0	100,0	
Missing	12	1	1,0		
	13	9	9,0		
	Total	10	10,0		
Total		100	100,0		

Source: Sample survey among the employees at the Customs Office of the International Airport "El. Venizelos" and A' Customs Office of Piraeus (Sept.-Oct. 2018).

According to the question on whether they believe that the reform should pertain to staff issues, such as the participation in decision making, Table 2 indicates a cumulative rate of 87,90% in favor of the stuff's participation in decision making (agree 62,60% and totally agree 25,30%) highlighting the willingness of the stuff to participate in this management system.

Table 2: Participation of the stuff in decision making, regarding the reform

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TOTALLY DISAGREE	1	1,0	1,1	1,1
	DISAGREE	1	1,0	1,1	2,2
	NOT AGREE / NOT DISAGREE	9	9,0	9,9	12,1
	AGREE	57	57,0	62,6	74,7
	TOTALLY AGREE	23	23,0	25,3	100,0
	Total	91	91,0	100,0	
Missing	13	9	9,0		
	Total	100	100,0		

Source: the same sample survey processing among employees at the Customs Office of the International Airport "El. Venizelos" and A' Customs Office of Piraeus (Sept.-Oct. 2018)

In Table 3, which refers to the ability of Heads of Units to set and allocate objectives and responsibilities, a rate of 25,30% responded negatively (totally disagree 4,40% and disagree 20,90%), a rate of 45,10% is neutral to this point of view (neither agree / nor disagree) and 29,60% accepts this point of view (agree 26,40% and totally agree 3,30%). It reflects the reality, since up to now target-setting process pertains to Heads of General Directorates, directorates and departments and not to the subordinates thereof, who constitute the vast majority of the employees and according to motivation theories incentives should be effective.

Table 3: The Heads of Units have the ability to set and allocate objectives and responsibilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TOTALLY DISAGREE	4	4,0	4,4	4,4
	DISAGREE	19	19,0	20,9	25,3
	NOT AGREE / NOT DISAGREE	41	41,0	45,1	70,3
	AGREE	24	24,0	26,4	96,7

	TOTALLY AGREE	3	3,0	3,3	100,0
	Total	91	91,0	100,0	
Missing	13	9	9,0		
	Total	100	100,0		

Source: same Survey Sample processing among workers at the Customs Office of the International Airport "El. Venizelos" and A´ Customs Office of Piraeus (Sept-Oct. 2018)

Crosstab of the question on whether the employees believe that there should be a total reform against the question regarding their age, with a Correlation Coefficient: Spearman Correlation Sig.(2-tailed) = 0,000, indicate that there is 100% acceptance (63% simple and 37% full) among new employees aged between 31-40 years old and as the age increases acceptance is declining. Reaching the upper age group (more than 61 years old), the observed results such as 40% cumulative acceptance, 33% neutrality and 20% complete disagreement. The impacts of the bureaucratic management system, as well as the simultaneous effect of reform ideas, as indicated in Table 4, are clearly observed.

Table 4: Age (F2) * A total reform is desirable (F13) Crosstabulation

Count

		F13					TOTAL
		TOTALLY DISAGREE	DISAGREE	NEITHER AGREE/NOR DISAGREE	AGREE	TOTALLY AGREE	
AGE (F2)	18-30	0	0	0	0	0	0
	31-40	0	0	0	63%	37%	100%
	41-50	3%	7%	10%	40%	40%	100%
	51-60	3%	9%	26%	44%	18%	100%
	61 AND UP	20%	0	40%	33%	7%	100%
TOTAL		6%	6%	21%	43%	25%	100%

Source: same Sample Survey processing among employees at the Customs Office of the International Airport "El. Venizelos" and A' Customs Office of Piraeus (Sept.-Oct. 2018)

The second subsection indicates that in a sample of 100 transactors- customs representatives, with an abstention rate of 17%, women participated at a rate of 23% and men at a rate of 60%.

The transactors aged between (31-40 years old) represent 19% of the participants, the transactors aged between (41-50 years old) represent 13%, the transactors aged between (51-60 years old) represent 34% and transactors above 61 years old represent 10%. It is observed that a cumulative rate of 44 % of the workers is above fifty years old

As far as it concerns the education level, a small participation of compulsory education graduates at a rate of 2%, high participation of secondary education graduates at a rate of 46%, a sufficiently high participation higher education graduates at a rate of 31% and a small participation of master degree holders at a rate of 4%, are observed

In Table 5, a cumulative rate of 43,40% of the sample disagrees with the point of view that permanence in employment may inhibit the efficiency and effectiveness of the customs office (totally disagree 20,50% and disagree 22,90%), 14,50% neutral position (neither agree/nor disagree) and a cumulative rate of 42,10% expresses agreement (agree 25,30% and totally agree 16,90%).

Table 5:The permanence of the employees suspends the efficiency and effectiveness of the customs office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TOTALLY DISAGREE	17	17,0	20,5	20,5
	DISAGREE	19	19,0	22,9	43,4
	NOT AGREE / NOT DISAGREE	12	12,0	14,5	57,8

		Frequency	Percent	Valid Percent	Cumulative Percent
	AGREE	21	21,0	25,3	83,1
	TOTALLY AGREE	14	14,0	16,9	100,0
	Total	83	83,0	100,0	
Missing	13	17	17,0		
	Total	100	100,0		

Source: same sample survey processing among customs representatives at the Customs Office of the International Airport "El. Venizelos" and A' Customs Office of Piraeus (Sept.-Oct. 2018)

In Table 6 a cumulative rate of 6 % of the participants (totally disagree 2,40% and disagree 3, 60%) responded negatively, a 15,70% was neutral (neither agree/ nor disagree) and a cumulative rate of 78,30% (agree 43,40% and totally agree 34,90%) agrees with the point of view that non-evaluation of the staff inhibits the efficiency and effectiveness of the customs office. It is also clearly indicated that for the transactors the evaluation of public service employees is unquestionable for the new management system.

Table 6: Non-evaluation of the staff inhibits the efficiency and the effectiveness of the customs office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TOTALLY DISAGREE	2	2,0	2,4	2,4
	DISAGREE	3	3,0	3,6	6,0
	NOT AGREE / NOT DISAGREE	13	13,0	15,7	21,7
	AGREE	36	36,0	43,4	65,1
	TOTALLY AGREE	29	29,0	34,9	100,0
	Total	83	83,0	100,0	
Missing	13	17	17,0		
	Total	100	100,0		

Source: Same sample survey processing among customs representatives at the Customs Office of the International Airport "El. Venizelos" and A´ Customs Office of Piraeus (Sept-Oct. 2018)

In table 7, a cumulative rate of 68,70% responded positively (agree 28,90% and totally agree 39,80%). The orientation of the sample of respondents regarding the negative impact of bureaucratic procedures on the efficiency and the effectiveness of the public service is clearly indicated.

Table 7: The existence of bureaucratic procedures inhibits the efficiency and the effectiveness of the customs office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TOTALLY DISAGREE	2	2,0	2,4	2,4
	DISAGREE	6	6,0	7,2	9,6
	NOT AGREE / NOT DISAGREE	18	18,0	21,7	31,3
	AGREE	24	24,0	28,9	60,2
	TOTALLY AGREE	33	33,0	39,8	100,0
	Total	83	83,0	100,0	
Missing	13	17	17,0		
	Total	100	100,0		

Source: Same sample survey processing among customs representatives at the Customs Office of the International Airport "El. Venizelos" and the A´ Customs Office of Piraeus (Sept.-Oct. 2018)

In table 8, the responses from the cross tabulation of the question on whether non-interoperability of the customs office with other public services, that hinders customs

procedures and trade facilitation poses a threat to customs office, against the question that ranks the transactors-customs representatives according to their age, using Spearman Correlation Sig. (2-tailed) = 0,029 indicate the following:

Observing the rates of negative and neutral responses, the first age group between 18-30 years old (with total rates of negative responses 14% and neutral responses 0%) and moving forward to older age groups the response rate increases, reaching at the last age group (over 61 years old), with a total negative response rate of 20% and neutral response of 40%). The greatest rates of negative responses and reflection on whether and to what extend non-interoperability of the customs office with other public services, hinders customs procedures, among longtime employees is largely due to the influence of the bureaucratic system that they have served for years and also due to the lack of interoperability which required an increased number of employees in this field, therefore a corporative viewpoint.

The cumulative rate of acceptance in the first age group between 18-30 is extremely high (total rate of 86%) and gradually decreases as we move forward to older age groups, reaching the last age group (total rate of 40%), that confirms this conclusion as observed in table 8.

Table 8: Age (G2) * Non-interoperability of public services poses a threat for customs procedures and office (G35) Crosstabulation

			G35			
		DISAGREE	NEITHER AGREE/NOR DISAGREE	AGREE	TOTALLY AGREE	TOTAL
Age (G2)	18-30	14%	0	43%	43%	100%
	31-40	5%	11%	26%	58%	100%
	41-50	0	23%	46%	31%	100%
	51-60	6%	18%	41%	35%	100%
	61 AND UP	20%	40%	20%	20%	100%
TOTAL		7%	18%	36%	39%	100%

Source: Same sample survey processing among customs representatives at the Customs Office of the International Airport "El. Venizelos" and A´ Customs Office of Piraeus (Sept.-Oct. 2018)

The third subsection, that attempts a correlation between common questions to the employees and the transactors, provides an overview of the total negative responses rate of 28,60% among the employees, as illustrated in diagram 7, regarding the contribution of a strategic and operational plan prepared by the Customs Office, within the Framework of the Independent Authority of Public Revenue., to the modernization of the Service, and 8,40% among the transactors, in diagram 8. A neutral responses rate of 35,20% among the employees compared to 36,10% among the transactors and a total acceptance rate of 36,30% among the employees compared to 55,40% among the transactors, were also observed.

The view is reflected, that despite their concerns, the transactors support the implementation of New Public Management, which facilitates an essential tool in comparison to the employees that appear to be less supportive of this view. Citizens may claim a better service quality from the employees and therefore an improved public management.

The diagram that follows reflects the view of the employees.

Diagram 1: The strategic and operational planning contributes to the modernization of the customs office
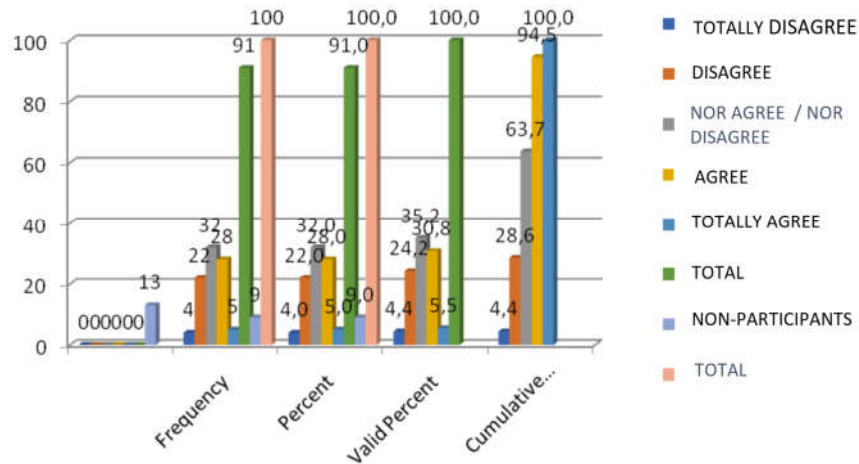
Source: Same sample survey processing among employees at the Customs Office of the International Airport "El. Venizelos" and A΄ Customs Office of Piraeus (Sept.-Oct. 2018)

Respectively the following diagram reflects the view of the transactors

Diagram 2: The strategic and operational planning contributes to the modernization of the customs office
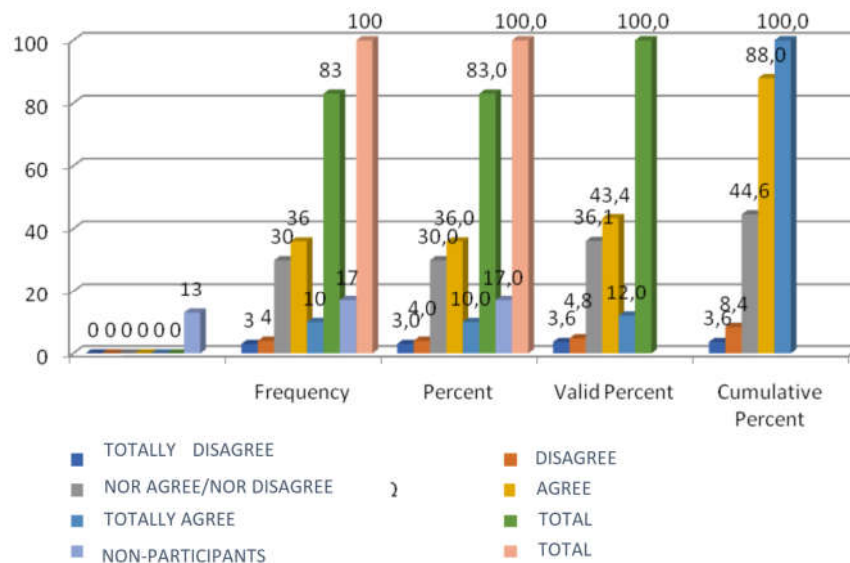
Source: Same sample survey processing among customs representatives at the Customs Office of the International Airport "El. Venizelos" and A΄ Customs Office of Piraeus (Sept.-Oct. 2018)

In the question regarding the record of the respondents' views on whether the implementation of NPM and TQM methods shall introduce a new culture to the customs office for the employees, the total acceptance rate amounts to 67,10% for the employees in diagram 9 and 63,90% for the transactors, in diagram 10. Justified concerns may also be reflected in neutrality rates of 18,70% for the employees and 21,70% for the transactors and in negative response rates of 14,30% for the employees and 14,50% for the transactors.

Comparatively:

As far as it concerns the effect of basic TQM functions on the employees' culture, total acceptance rates of 67,10% for the employees and 63,90% for the transactors, are observed. Assessable negative response rates of 14,30% for the employees and 14,50% for the transactors as well as neutral response rates of 18,70% for the employees in comparison to 21,70% for the transactors, which mainly refer to the effect of the bureaucratic management system are also displayed.

The viewpoint of the employees is also illustrated in the following diagram.

Diagram 3: The measurement of efficiency and effectiveness according to the processes of New Public Management, introduces new culture to the customs office for the employees.
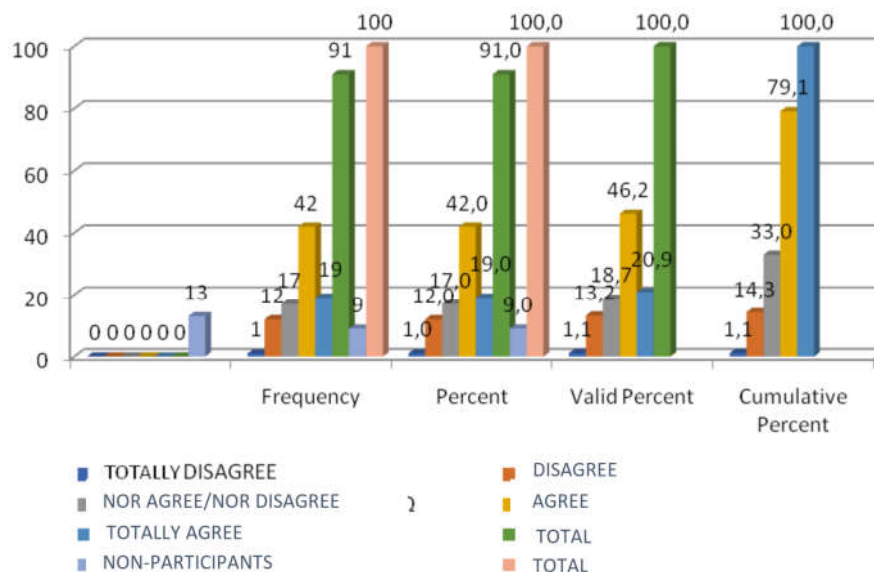
Source: Same sample survey processing among employees at the Customs Office of the International Airport "El. Venizelos" and A´ Customs Office of Piraeus (Sept.-Oct. 2018)

Respectively the viewpoint of the transactors is illustrated in the following diagram.

Diagram 4: The measurement of efficiency and effectiveness according to the processes of New Public Management, introduces a new culture to the customs office for the employees
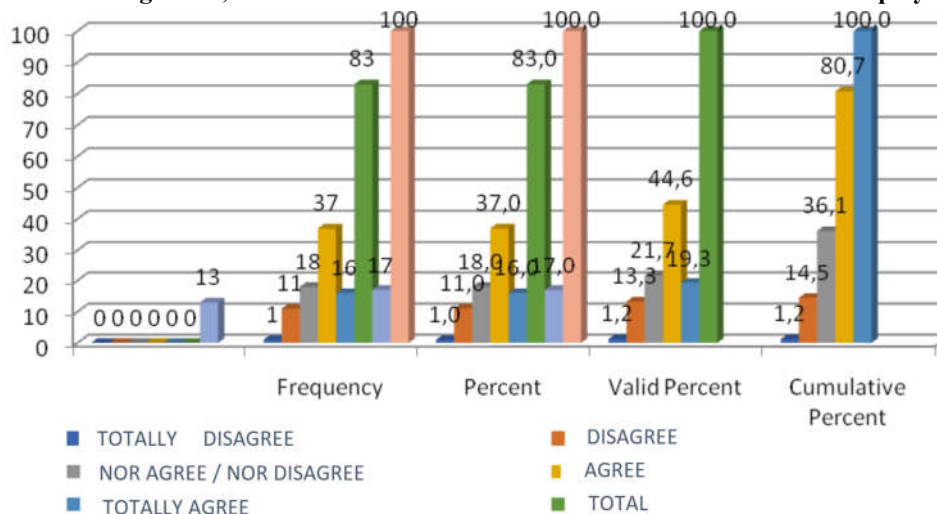
So urce: Same sample survey processing among the customs representatives at the Customs Office of the International Airport "El. Venizelos" and the A´ Customs Office of Piraeus (Sept.-Oct. 2018)

4. Conclusions and recommendations

The approach of Total Quality Management as a comprehensive reform has become popular among the employees at the customs office as well as the parties transacting with it.

They aspire to the fact that the implementation of principles of T.Q.M. by means of New Public Management processes, shall introduce a new culture to the customs office and will allow it to shape its vision at a national level, contributing to the reform of public management in accordance with Boston's study as well as at an international level in the context of the E.U. and WTO.

This reform could result from internal procedures with the use of the respective methodological tools such as Common Assessment Framework.

The adoption of an external reform in the context of principles of T.Q.M. provokes a negative attitude and raises concerns, which are also associated with an unsatisfactory level of

information and communication among the parties involved in the new management system. Those in charge in the customs office maintain a more cautious approach towards the reform in comparison to those who are not in positions of responsibility, who comprise the majority of the employees. The reform is also more popular among employees with previous experience in the private sector. Vinni's study also leads to a similar conclusion.

Key processes of N.P.M. and T.Q.M. such as strategic and business planning have not been communicated to the employees at the customs office, much less to customs representatives transacting with the customs office. Typical is the fact that the employees fully accept the relevance of the objectives and the business plan, but they don't share the same level of acceptance regarding the potentials of a strategic and business plan.

The extent to which information technology is used as well as the introduction of innovations, in line with the study of Persson & Goldkuhl, is very satisfactory. The introduction of innovation and IT, such as the Integrated Customs Information System (ICISnet) in combination with Risk Analysis, have added to the efficiency of the customs office by performing even more and complex procedures in much less time and without physical presence and have become widely accepted by the employees and the transactors. "According to Durst and Newell (1999), Dionysopoulou P. & Kouremadi M., (2017), internet as well as software systems used by organizations, such as ''ERP, Knowledge Management'' contribute to transparency and time-efficiency in implementing the organization's strategy. Therefore, it improves the efficiency and effectiveness of each organization using technological innovation".

Regarding customs processes, the employees share the opinion that bureaucratic processes continue to exist, but in their perception, they are in a transitional phase and they are increasingly concerned mainly about time conjuncture. This can be explained by the fact that the employees comprehend the progress that has been made on a daily basis, in comparison to the past, but they also acknowledge that bureaucracy and lacking process organization that still exist to a lesser extent, constitute inhibitory factors, in line with the findings of Thompson and Thompson's report. The same findings also apply to the transactors, who experience bureaucracy, but acknowledge the changes that have been made to structures and processes, whereas new transactors are in favor of further redesign of structures and processes.

The employees support an evaluation based on objective parameters, but they don't question employment permanence. They are also in favor of target-setting and incentives that must be shaped, according to the procedures laid down by the system and involve the participation of all employees. They fully accept team work and efficient performance and point out their willingness to participate. They clearly refrain from practices of the past regarding employment, which must be carried out according to the actual needs of the office, promotions that will be based on evaluation through a modern Human Resource Management system and the establishment of an objective incentive scheme, depending on the findings of Soltani, Meer, Gennard, &Williams, relating to a research on behalf of Q.S.F. Younger employees as well as those with a higher educational level are more receptive to the implementation of TQM principles using the structures of NPM.

Customs representatives transacting with the office acknowledge the improvements that affect their daily work and make it flexible and efficient, but they also note the lacking training of the staff in new methods of public service. Younger employees also pursue further redesign concerning well-established perceptions of the employees and the transactors, such as the effectiveness of employment permanence in the new management system. Older transactors are underpinned by an outdated management culture. In general, the opinion of mostly older age employees and transactors is clearly influenced by a bureaucratic management system.   At this point one can easily observe similarities with the aforementioned Q.S.F. research, regarding the precedence of transactors' contentment over the strict adherence to the processes according to Vemberian approach.

The new management system establishes target-setting processes with the participation of all the parties and measurable results. The predominance of the new system shall bring about a new work routine for employees and transactors. This change shall breath a new vision into the public management and public service in general, as referred to in the study of Prajogo and McDermott.

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MODELING OF SYSTEM FACTORS OF FINANCIAL SECURITY OF AGRICULTURAL ENTERPRISES OF UKRAINE

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Abstract
The article considers the process of modeling of systemic factors of financial security of agricultural enterprises of Ukraine. The methodology of complex, systematic assessment of fiscal security and mathematical tools in the deterministic space of the financial system of enterprises are substantiated. A systematic approach is used, which determines the quantitative and qualitative parameters of external and internal threats, identifies the threshold interval of stable financial condition and stable development of agricultural enterprises. Systemic factors of stimulating and disincentive character for an estimation of financial safety of the agricultural enterprises are developed. A set of indicators for the analysis of the state of the functional components of financial security, provided by the process of neutralization of real and potential threats to the stable potential of financial security of enterprises is determined. The expediency of normalization of indicators is substantiated, their threshold values, weights and capital structure are taken into account when calculating the integrated level of financial security. It is proved that the introduction of systemic factors in the general level of financial security allows increasing the level of financial stability and reliability of agricultural enterprises.
Keywords: financial security, potential of financial security, efficiency, threats, agricultural enterprises, financial condition, financial balance.
JEL classification: G01, G21, G32, H12, Q14

1. Introduction

Financial instability, economic contradictions and objective inevitable transformation processes that have arisen in the agricultural sector of the economy require in-depth study of financial security of agricultural enterprises, the determined level of financial condition of which does not provide stable protection from external and internal threats. Accordingly, the financial philosophy of sustainable growth of agricultural entities needs to reconsider the priorities of their financial security to strengthen the national and food security of the state.

In the period of formation of regularities of natural connection between components of financial safety of subjects of agricultural development, the material basis of their financial

potential in the form of system, which consists of finite number of elements and has accurately expressed properties of financial resources, is allocated. This proves that the interconnected and interdependent specific features of the systemic factors of financial security determine the formation of the total amount of financial resources for the continuous movement of financial flows and ensure the reproduction process of the financial cycle. The study of financial security of agricultural enterprises is provided within the framework of several theories that use the systematization of knowledge and ways to transfer this knowledge to the multidisciplinary stages of the reproduction process of stable financial condition of economic entities. Fixation of stages in this context embodies the cognitive process of building a stable model of financial development of economic entities.

The theoretical foundations of financial security were researched by O. Baranovskyi (2004), A. Gukova and I. Anikina (2006), I. Komarnytskyi (2010), A. Sukhorukov and O. Ladiuk (2007), F. Fafurida, A.B. Setiawan and S. Oktavilia (2019); development of measures to ensure financial security in the agricultural sector of the economy was studied by V. Arefiev (2010), O. Vdovenko (2014), O. Hryvkivska (2012), O. Hudz (2013), N. Davydenko (2013), M. Demianenko and O. Zuieva (2010) and others. The concept of formation of financial security of agriculture in the context of financial activity of agrarian enterprises is considered W. Coleman, G. Skogstad and M. Atkinson (1996), C.-H. Ling, H.-L. Yang and D.-Y. Liou (2009), W. Moyer and T. Josling (2002), M. Petrick (2003) as a regulatory function of economic entities development with a justification of the principles of protection of their livelihoods; O. Zhydyak (2013), V. Korneyev (2009), T. Kuzenko (2010) as an assessment of the sectoral level of financial support for the industry and the development of a strategy for financial security of agrarian enterprises in the regions; O. Baranovskyj (2004), M. Yermoshenko (2001), S. Frunza (2010) as an priority of ensuring the national and individual interests of the subjects through overcoming financial contradictions, the formation of effective capital and state control over its use, the formation of macro and microfinance stability.

Financial security is often studied from the prognostic point of view of the possible influence of the external and internal environment on the formation of a stable financial condition and ensuring the financial stability of business entities that have developed in the works of C. Balomenou and M. Maliari (2013), V. Boronos (2011), V. Heyts (2009), H. Kramarenko (2003), H. Chesbrough (2010), A. Pantazis and T. Pelagidis (2017), L. Leyfer (2003), J. Gaspar, P. Vasconcelos and O. Afonso (2014). However, the scientific views of these researchers do not fully cover the current risks of transformational trends in the agricultural sector of the economy, based on the principles and patterns of strengthening the financial security. This complex and multifaceted issue is considered by individual elements and levels (Dovgal et al., 2017; Mohammad Aliha et al., 2019). This complicates its comprehensive study as a single system and the establishment of existing intersectoral correlations.

The priority of our study is to substantiate the methodology and mathematical tools for modeling the systemic factors of financial security of agricultural enterprises, which based on a systematic approach, determine quantitative and qualitative parameters of external and internal threats to identify the threshold interval of their stable financial condition and stable development.

2. **Materials and Methods**

Financial security is a platform for the mechanism of stable development of the entity, which identifies protective tools and measures for the rational use of financial resources, enhanced by the high dynamism of market relations, the constant generation in this process of new information about the nature of risk. Naturally, in the conditions of formation of a new model of financial security of agricultural enterprises, most of them did not show the ability to systemic changes in future development, financial opportunities and strengthening of a stable financial condition. Accordingly, external and internal risk factors that disrupt the normal functioning of the process of reproduction of financial resources cause uncertainty and threats of loss of positive results, irrational use of equity and debt capital, violation of dividend and depreciation policy, communication management of financial flows, financial reserves, receivables and payables, profit distribution. The lack of methods of normalization of

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financial security subsystems in this aspect does not allow generating sufficient financial resources and ensuring the restoration of important economic and financial relations.

The level of financial security of economic entities should be considered in terms of a systematic approach, which embodies a number of elements of an arbitrary set that interact as a whole and function in accordance with certain patterns inherent in this complex. From the standpoint of emergence, financial security is characterized by the quality of synergy, which in the general theory of systems forms the interdependence of the elements of the system, providing a comprehensive effect. That is, the level of financial security has all the properties of a cybernetic system, in particular the presence of information channels between its individual elements; multivariate behavior of the system; controllability and purposefulness of the system, which in some way interacts with the aggressive environment (Fig. 1).

Figure 1: Interaction of financial security of the agricultural enterprise and the external environment
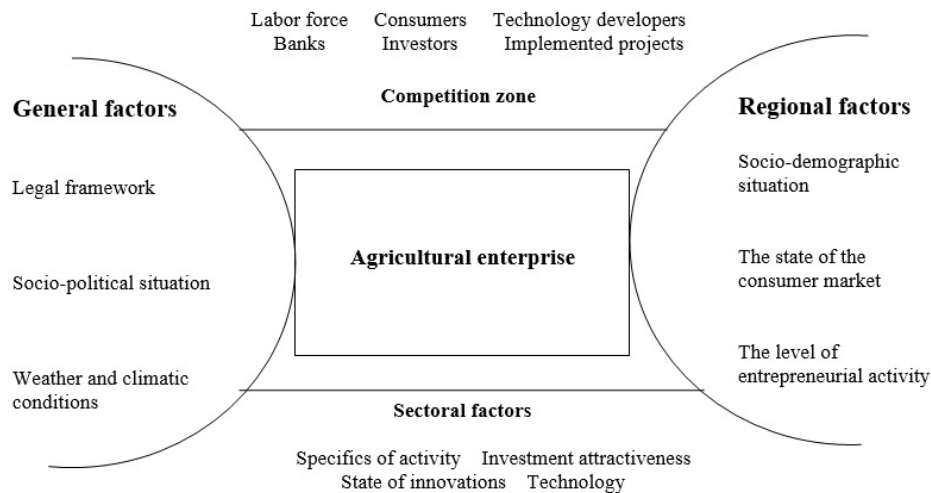
To improve the financial security of agricultural enterprises, we have proposed a model system of factors that, through analyzing and summation of individual functional criteria k_i, ((as the ratio of the possible value of the entity z_i (liquidity, financial stability, business activity and profitability) to the value of the components of financial security), prevents the emergence of threats to a stable financial condition s_i, i.e. (Korneyev, 2009; Marta-Costa et al., 2012):

$$k_i = \frac{z_i}{s_i}, \quad i = \overline{1, n},. \quad (1)$$

where, n – the number of functional components of the financial security of the agricultural enterprise.

In this case, the integrated indicator of the level of financial security of any business entity I will be calculated as (Hreshchak et al., 1999; Kim et al., 1989):

$$I = \sum_{i=1}^{n} \lambda_i k_i, \quad (2)$$

where, λ_i – the share of significance of the i-th functional component.

Systemic factors may differ depending on the specifics of the operation of the business entity, as well as change for the same entity at different stages of its life cycle. Accordingly, the level of financial security will have the following functional dependence (Oleynikova, 1997):

$$I = \alpha_1 f(x_1) + \alpha_2 f(x_2) + ... + \alpha_n f(x_n), \quad (3)$$

where, $x_1, x_2,..., x_n$ – performance indicators of the agricultural enterprise (financial security indicators); $f(x_1), f(x_2), ..., f(x_n)$ – local functions of dependence of the level of financial security on the relevant indicators of the agricultural enterprise; $\alpha_1, \alpha_2,..., \alpha_n$ – systemic factors that reflect the importance of each indicator to ensure the financial security of the entity.

It is proposed to determine the system factors α_i for the degree of achievement by the business entity of such an "ideal" state, which is the best in terms of development dynamics and performance. This "ideal" state is set by the limit values of indicators of financial condition, exceeding or underestimating of which negatively affects the ability of agricultural

enterprises to develop. That is, indicators of the level of financial security are normalized values of indicators of financial condition (stability) (Shlemko and Binko, 1997):

$$z_i = \left(\frac{P_{if}}{P_{ig}}\right)^b, \quad (4)$$

where, P_{if}, P_{ig} – respectively, the actual and limit values of the i-th indicator; b – an indicator of the degree.

The exponent b in model (4) takes two values: for stimulatory factors it is equal to 1, for destimulatory factors it is equal to -1. The limit values of the indicators are determined based on the condition of the minimum permissible level of safety. The range of possible values of each indicator is divided into 5 intervals (Reverchuk, 2004):

$$\left[x_{gr}^n, x_{por}^n\right), \left[x_{por}^n, x_{opt}^n\right), \left[x_{opt}^n, x_{opt}^v\right), \left[x_{opt}^v, x_{por}^v\right), \left[x_{por}^v, x_{gr}^v\right), \quad (5)$$

where, x_{gr}^n, x_{gr}^v – the minimum and maximum value (or lower and upper limit) of the indicator of financial security of the agricultural enterprise; x_{por}^n, x_{por}^v – respectively lower and upper threshold values of the indicator; x_{opt}^n, x_{opt}^v – minimum and maximum interval of optimal values of the indicator. The value x_{opt}^n can be equal to x_{opt}^v, then the interval [x_{opt}^n, x_{opt}^v] turns into a point x_{opt}. The values $x_{gr}^n, x_{por}^n, x_{opt}^n, x_{gr}^v, x_{por}^v, x_{opt}^v$ in model (5) are determined by the expert method. Normalized values of financial security level indicators are calculated as follows (Reverchuk, 2004):

$$z_i = \begin{cases} \dfrac{x_i - x_{gr}^n}{x_{por}^n - x_{gr}^n}, & x_{gr}^n \leq x_i \leq x_{por}^n; \\[2mm] \dfrac{(x_i - x_{por}^n) + x_n^*(x_{opt}^n - x_i)}{x_{opt}^n - x_{por}^n}, & x_{por}^n \leq x_i \leq x_{opt}^n; \\[2mm] 1, & x_{opt}^n \leq x_i \leq x_{opt}^v; \\[2mm] \dfrac{x_v^*(x_i - x_{opt}^v) + (x_{por}^v - x_i)}{x_{opt}^v - x_{por}^v}, & x_{opt}^v \leq x_i \leq x_{por}^v; \\[2mm] \dfrac{x_{gr}^v - x_i}{x_{gr}^v - x_{por}^v}, & x_{por}^v \leq x_i \leq x_{gr}^v, \end{cases} \quad (6)$$

where, $x_n^* = 0$ and $x_v^* = 0$.

After finding the normative value of indicators, a comprehensive rating indicator of the level of financial security of the enterprise is calculated (Sheremet and Sayfulin, 1995):

$$I = \sqrt{\sum_{i=1}^{m}(1 - z_i)^2}, \quad (7)$$

where, m – the number of indicators of the financial condition of the enterprise; z_i – normalized values of indicators of the financial condition of the enterprise.

In this case, we propose to consider the financial condition of the enterprise $S(t)$ at the time t as a set of such indicators (diamond of the financial condition of the enterprise) (Kyzym et al., 2003):

$$S(t) = \{O(t), L(t), D(t), H(t)\}, t \in [0, T), \quad (8)$$

where, $O(t)$– the value of the turnover of capital of the enterprise (turnover ratio of current assets); $L(t)$– the value of the liquidity ratio of the capital of the enterprise (total coverage ratio); $D(t)$– the value of the rate of return on capital of the enterprise (profitability ratio); $H(t)$– the value of the capital independence of the enterprise (the ratio of equity and borrowed capital).

To assess the dynamics of the financial condition of the enterprise it is necessary to compare the actual indicators of the diamond of the financial condition with their base platform (values of past periods). Then the model of the dynamics of the financial condition of the enterprise $I(t)$ will look like (Kyzym et al., 2003):

$$I(t) = \left\{\frac{O_f(t)}{O_b(t)}, \frac{L_f(t)}{L_b(t)}, \frac{D_f(t)}{D_b(t)}, \frac{H_f(t)}{H_b(t)}\right\}, (9)$$

where, $O_f(t)$, $L_f(t)$, $D_f(t), H_f(t)$ – the actual values of indicators that characterize the financial condition of the enterprise at the time t; $O_b(t)$, $L_b(t)$, $D_b(t)$, $H_b(t)$– basic values of indicators that characterize the financial condition of the enterprise at the time t.

The set of indicators of financial condition, which are included in the model design of system factors must contain an integral limit distance of the real level of financial security of the enterprise in relation to the "reference", which should be equal to (Trusova et al., 2019):

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$$d(A_i, A_0) = \sqrt{\sum_{j=1}^n (x_{ij} - x_{0j})^2}, \qquad (10)$$

where, $d(A_i, A_0)$ – the integral marginal distance of the level of financial condition of the enterprise in relation to the "reference"; x_{ij} – the value of the j-th indicator for the i-th enterprise; x_{0j}– the value of the j-th indicator, which corresponds to the "reference" (normative value of the indicator).

The integrated indicator$d(A_i, A_0)$ shows the level of deviation of the financial condition of the i-th enterprise from the "reference" level of financial security. If $d(A_i, A_0) = 0$, it means that the company has achieved the optimal value of security. An increase in the distance from the "reference" value in the dynamics indicates deterioration in financial condition and a decrease in the level of financial security. Valuesx_{0j} are critical and are determined by the principle of deviation of the indicator of the level of financial security of the enterprise (liquidity, financial stability and profitability) from the "reference".

This methodological approach makes it possible to model the systemic factors that provide a stable level of financial security in order to form the total value of gross investment of the enterprise and the resources needed for investment support and development of economic entities (Kozachenko et al., 2003):

$$I_t = \frac{BI_t}{IP_t}, \qquad (10)$$

where, BI_t – gross investment of the enterprise at the time t;IP_t – investment of the enterprise at the time t, necessary to ensure financial security.

In the case when the value I_t is close to one, it indicates a high level of financial security of the enterprise. In this case, the overall financial security potential of agricultural enterprises will be manifested as the competitive status of the total amount of financial investments (*KSP*) (Gukova and Anikina, 2006):

$$KSP = \frac{(I_f - I_k)}{(I_o - I_k)} \times \left(\frac{S_f}{S_o}\right) \times \left(\frac{C_f}{C_o}\right), \qquad (11)$$

where, I_f – the actual level of strategic financial investment of the enterprise; I_o – the optimal amount of strategic financial investment of the enterprise; I_k – the minimum critical level of strategic financial investments of the enterprise; S_f, S_o – parameters of the current and optimal strategy of the enterprise; C_f, C_o – parameters of the existing and optimal potential of financial security of the enterprise.

In addition, a characteristic feature of the overall potential of financial security is the diagnosis of the functionality of the enterprise through the indicators of compliance of the *i*-th element of financing (Gukova and Anikina, 2006):

$$P = \sqrt[m]{\prod_{i=1}^m PV_i}, \qquad (12)$$

where, P– the state of financial capabilities of the enterprise; PV_i – indicator of compliance of the *i*-th element of financing of functional capabilities and stable development (investment) of the enterprise; m – the number of functional capabilities of the enterprise.

The indicator of compliance of the *i*-th element of financing to the functionality and stable investment of the enterprise PV_i is determined as follows (Shkarlet, 2007):

$$PV_i = \sqrt[n]{\prod_{j=1}^n R_{ij}}, \qquad (13)$$

where, R_{ij} – indicator of the *i*-th element of financing of functional capabilities and stable development (investment) of the enterprise, compliance with the provision of its *j*-th financial resource; k_i^g – the coefficient of significance of the *i*-th element of financing the functionality of the financial security potential of the enterprise; k_j^v – the coefficient of compliance of the *j*-th resource with the requirements that meet the stable development (investment) of the enterprise; k_{ij}^z – the coefficient of security of the *i*-th element of financing of functional capabilities of *j*-th financial resource.

$$R_{ij} = k_i^g \cdot k_j^v \cdot k_{ij}^z \qquad (14)$$

A quantitative feature of estimating the total value of the financial security potential of the enterprise is the difference between the consolidated value of the total amount of income and expenses (Shkarlet, 2007):

$$V = \frac{D}{R_{mr} \cdot K_d} - (V_{na} + V_{ma}), \qquad (15)$$

where, V – a generalized assessment of the potential of financial security; D – income (net financial (cash) flow) of the enterprise; R_{mr} – the average industry level of profitability of economic activity; K_d – the coefficient of profitability of economic activity of the enterprise; V_{na} – the total value of all assets of the enterprise less tangible assets; V_{ma} – the total value of all tangible assets of the enterprise.

This difference reflects the balance of value (usefulness), which cannot be attributed to any of the assets of the enterprise. At the same time, the use of systemic factors of financial security determines the definition of qualitative and basic parameters of the process of managing the value of financial flows, thus providing a comprehensive assessment and multifactor modeling of the stable financial condition of agricultural entities. Accordingly, the variability of financial transactions of economic entities should cover all possible changes in the structure of sources of financing. First, each financial transaction determines the cycle of financial flow, in the process of which there are changes in the composition of financial resources and sources of funding. Second, the total amount of financing changes when financial transactions provide a regrouping of the structure of property assets (Pelagidis and Tsahali, 2019; Mohammad Aliha et al., 2018; Hasyim et al, 2019; Koudoumakis et al., 2019). That is, this variability of operations is determined by the need to finance variable costs and costs associated with the replacement of machinery and equipment (Pantazis and Pelagidis, 2017). Third, the balance between financial resources and their sources must be maintained after any financial transaction. This equality arises with the redistribution of financial resources, i.e. with an increase or decrease in the amount of financial potential, which significantly affects the integrated level of financial security of agricultural enterprises (Trusova, 2016).

Thus, from the standpoint of a complete approach to modeling the systemic factors of financial security of agricultural enterprises, we propose to use a multiplicative function that identifies local indicators (systemic stimulants, the growth of which has a positive effect on the aggregate indicator) of development of economic entities, taking into account possible threats to the functionality of the economic process:

$$B_t = \prod_{i=1}^{n} u_{ti}, \quad t = \overline{1, T} \qquad (16)$$

where, n – the total number of indicators that characterize the potential of financial security of the enterprise ($n = 56$); t – time period number; v_{ti} – the value of the i-th indicator that characterizes the activities of the enterprise at the time t;

$$u_{ti} = \frac{v_{ti}}{\max\limits_{t \in [1,T]} v_{ti}}, \qquad (17)$$

$t = \overline{1, T}, \quad i = \overline{1, n}$ – the threshold criteria of each indicator that characterizes the financial security potential of the enterprise.

Values u_{ti} characterize the relative deviation of the value of each financial security indicator relative to its maximum level for the period [1, T].

At the same time, the possibility of the potential of financial security, during which a certain amount of balances of financial resources may be in non-monetary form, should be aimed at making short-term financial investments. The generalized level of financial security should cover inflation losses from the depreciation of the national currency and provide investment income, in accordance with the target or actual level of profitability.

3. Results and Discussion

Agriculture, which is a rather specific sector of the economy and has a number of features, has a significant impact on sectoral aspects of agricultural enterprises. The study of the parameters of systemic factors of financial security of economic entities of the Steppe zone allowed identifying their relationship with macroeconomic processes that affect the efficiency of entities (Table 1).

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Table 1: Interdependence of profitability and indicators of financial condition of agricultural enterprises of the Steppe zone of Ukraine on average for 2016-2019

Indicators	Groups of enterprises by the level of profitability of operating activities								
	1	2	3	4	5	6	7	8	9
The share of enterprises in the group, %	4.1	5.7	19.8	22.8	24.4	14.6	2.2	3.6	2.8
The level of profitability, %: - of operating activities	-19.3	0.0	2.9	15.6	24.9	36.6	47.0	57.1	63.8
- of capital use	-22.9	-13.1	2.3	9.3	15.6	22.1	20.9	30.4	27.8
The number of assets turnover per year	0.71	0.96	1.12	1.22	1.88	1.82	1.34	0.81	0.69
- of cash	0.88	1.18	1.29	1.63	2.46	1.24	1.01	0.78	0.41
Per capita per 1 hectare of agricultural land, USD: - income	4643	5963	5428	7350	9702	18455	13013	7937	6014
- net profit	-1120	-330	244	582	1520	3179	2799	3562	5277
- assets	3673	3999	5994	9576	10988	14360	18909	9141	8496
Financial independence ratio	-0.34	0.00	0.55	0.71	0.72	0.83	0.83	0.95	0.71
Coverage ratio	0.78	1.54	10.38	17.28	10.56	1.80	22.03	14.66	3.11
Rapid solvency ratio	0.34	1.54	2.95	4.97	2.48	1.53	19.62	8.85	2.85
Depreciation rate of fixed assets	0.75	0.67	0.59	0.51	0.49	0.51	0.42	0.41	0.42
The ratio of maneuverability of working capital	-1.54	-1.20	0.27	0.43	0.58	1.04	0.84	0.93	0.54

Thus, the insufficient level of efficient activity of agricultural enterprises of groups I and II is the cause of loss of equity, deterioration of the structure of sources of financing, insufficient provision of economic resources and other processes. At the same time, the destabilization of the financial condition of enterprises worsens the conditions of their operation and leads to insolvency, reduced investment attractiveness and creditworthiness and, consequently, makes it impossible to attract financial resources from external sources. Improving the concentration of capital in general has a positive effect on the financial condition and efficiency of agricultural enterprises (Table 2). At the same time, due to its excessive increase, the effectiveness of such influence is lost. This is explained by the fact that in some enterprises the attraction of additional capital is not supported by its rational investment in the acquisition of fixed and current assets, as well as ensuring their effective use in the economic process.

Table 2: The impact of capital concentration on the financial condition of agricultural enterprises in the Steppe zone of Ukraine on average for 2016-2019

Indicators	Groups of enterprises by level of capital concentration per 1 ha of agricultural land								
	1	2	3	4	5	6	7	8	9
Share of enterprises, %	3.2	1.6	11.5	18.2	7.8	24.5	4.7	18.7	9.8
Limits of fluctuations in capital concentration, thousand USD	≤ 1.50	1.51-3.00	3.01-4.50	4.51-6.00	6.01-7.50	7.51-9.00	9.01-10.50	10.51-12.00	> 12.00
Average cost of capital, USD	1112	2299	3677	5176	6972	7906	9150	11051	13623
Financial independence ratio	0.50	0.52	0.54	0.71	0.80	0.82	0.60	0.42	0.39
Financial stability ratio	0.58	0.62	0.63	0.83	0.77	0.83	0.81	0.67	0.41
Investment ratio	6.87	4.61	3.13	2.56	2.06	1.62	2.21	1.55	0.96
Current liabilities coverage ratio	3.33	7.62	8.31	12.24	7.74	6.84	6.29	7.28	2.13
Rapid solvency ratio	2.12	4.17	1.19	3.10	1.84	2.11	2.27	3.23	1.19
Absolute solvency ratio	0.30	2.21	1.09	2.27	0.28	0.53	0.12	0.50	0.06
Maneuverability ratio of current assets	0.36	0.61	0.25	0.53	0.65	0.53	0.42	0.60	-0.52
Suitability ratio of fixed assets	0.63	0.58	0.55	0.53	0.56	0.43	0.54	0.58	0.37
Assets turnover ratio	2.23	1.01	0.75	0.58	0.64	0.46	0.46	0.28	0.53

Indicators	Groups of enterprises by level of capital concentration per 1 ha of agricultural land								
	1	2	3	4	5	6	7	8	9
Per 1 ha of agricultural land, USD: - income	1743	2025	2369	2602	3769	3906	3657	2857	4164
- operating activities	98	355	427	599	805	740	1160	960	-113
The level of profitability of operating activities, %	6.51	19.26	21.52	25.74	21.08	28.45	20.88	20.95	-0.86

Thus, when the concentration of capital increases to 6-9 thousand USD per 1 hectare of agricultural land independence and resilience are strengthened, and then there is a reverse process. In addition, the growth of capitalization to the level of 9 thousand USD per 1 ha of agricultural land leads to improved performance and increased operating income, while with a further increase in concentration, the efficiency of its use is significantly reduced. A similar trend is observed for the profitability indicator of operating activities. At the same time, the straightforward relationship between sales revenue and capital concentration is stronger, as the correlation coefficient reaches 0.87. As the level of debt increases, the coefficient of financial stability decreases, which in 6-9 groups of agricultural enterprises becomes critical (Table 3) and is accompanied by deterioration in the level of investment and maneuverability.

Table 3: Relationship of debt with indicators of financial stability of agricultural enterprises of the Steppe zone of Ukraine on average for 2016-2019

Indicators	Groups of enterprises by value of debt ratio								
	1	2	3	4	5	6	7	8	9
Share of enterprises, %	3.4	11.6	5.4	7.3	24.5	26.7	12.4	4.9	3.8
Limits of debt ratio	≤ 0.125	0.126- 0.250	0.251- 0.375	0.376- 0.500	0.501- 0.675	0.676- 0.750	0.751- 0.875	0.876- 1.000	> 1.000
Debt ratio	0.07	0.19	0.32	0.45	0.54	0.70	0.83	0.97	1.12
Financial stability ratio	0.94	0.87	0.73	0.59	0.57	0.35	0.26	0.25	0.21
Short-term debt ratio in debt capital	0.88	0.64	0.82	0.92	0.80	0.93	0.89	0.77	0.71
Investment ratio	6.27	2.45	2.29	1.69	1.86	1.35	0.65	0.23	-0.68
Equity maneuverability ratio	0.55	0.46	0.39	0.22	0.37	-0.39	-0.49	–	–
Current assets maneuverability ratio	0.88	0.62	0.49	0.07	0.16	-0.87	-0.13	-0.07	-0.10
Fixed assets suitability ratio	0.58	0.59	0.46	0.47	0.55	0.61	0.60	0.45	0.55
Ratio of fixed assets security with current assets	4.83	1.70	1.95	1.91	2.73	3.11	2.78	6.14	6.05
Current share of retained earnings in equity	35.7	33.0	31.6	23.0	38.2	35.5	-14.4	-71.2	–

Thus, in 7-9 groups the investment ratio does not reach one, in 6-9 groups there is an unsatisfactory level of maneuverability of equity and current assets. Negative dynamics is observed in the enterprises of groups 4-9 due to irrational placement of borrowed funds in assets, because equity is not enough to finance non-current assets and inventories, which indicates a lack of financial stability. In farms of groups 7-9, the amount of financing does not provide financial stability, even when using a combination of long-term liabilities and short-term bank lending. A stronger relationship is observed between financial stability and the efficiency of agricultural enterprises (Figs. 2-3). However, the increase in the level of debt is accompanied by a decrease in the profitability of assets and operating activities, as well as the share of operating profit in income.

This connection is quite logical, because, on the one hand, borrowing requires interest, which reduces the efficiency of their operation, and on the other - the low level of profitability makes it difficult to form their own financial sources due to lack of capitalized income.

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Figure 2: Interdependence of financial stability and indicators of financial condition of agricultural enterprises of the Steppe zone of Ukraine on average for 2016-2019
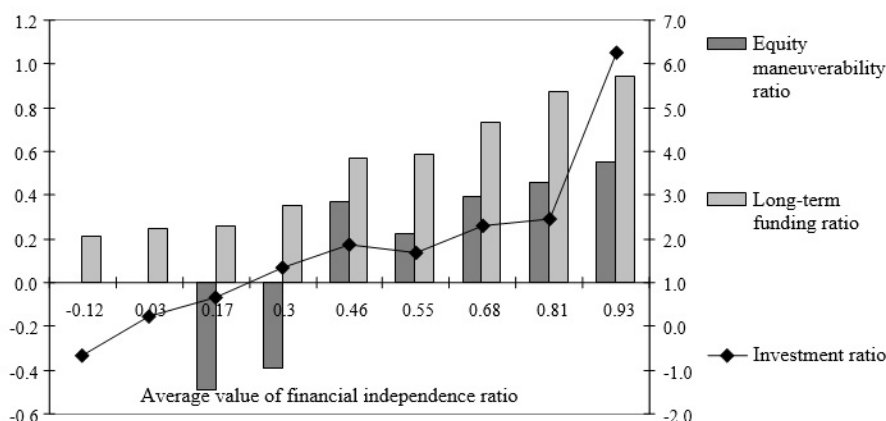
Figure 3: Interdependence of financial stability and effective activity of the agricultural enterprise of the Steppe zone of Ukraine on the average for 2016-2019
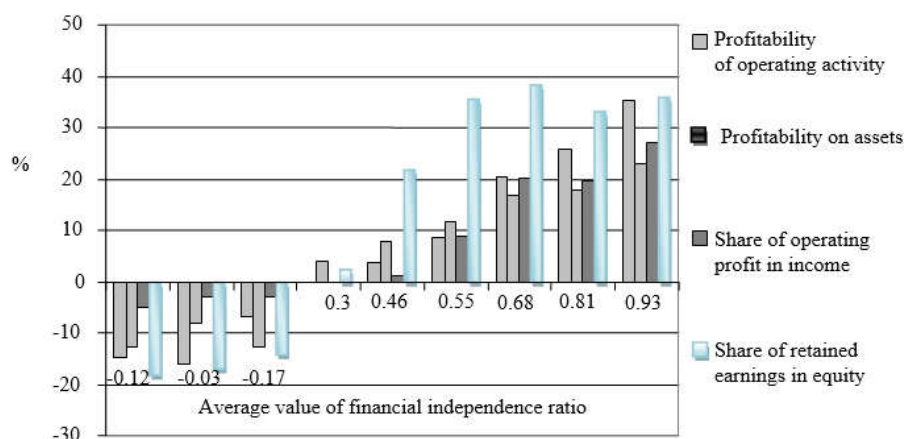
Important systemic factors-disincentives of financial security of economic entities of the Steppe zone of Ukraine are the lack of relationship between the level of mobility and the structure of current assets (Fig. 4). Thus, in general, the level of asset mobility for the period 2016-2019 ranged from 6.6 to 95.0%, in more than 50% enterprises it ranged from 34.9 to 54.9%.

Figure 4: Interdependence between mobility and structure of current assets of agricultural enterprises of the Steppe zone on average for 2016-2019
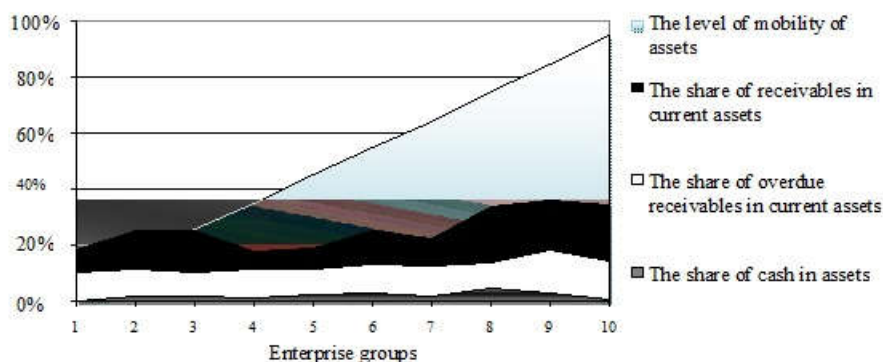
At the same time, the share of total and overdue receivables in current assets fluctuated in groups from 17.7 to 36.3% and from 10.1 to 18.7%; the share of cash in assets in these groups – from 0.4 to 4.9% and did not have a clear trend.

The stochastic nature of forecasting external and internal threats to identify the threshold interval of stable financial condition and stable development of agricultural enterprises allows identifying many factors that discourage financial security by reducing indicators such as: return on assets (deterioration occurs due to reduced efficiency and crisis in financial condition); debt ratio (deterioration of the structure of liabilities and the emergence of a crisis of funding sources); indicator of adequacy of financing of illiquid assets (indicator of threat to financial stability and asset formation); asset turnover ratio (slowdown indicates the emergence of a liquidity threat); the coefficient of maneuverability of current assets (signals the threat to liquidity and solvency).

The assessment of the level of financial security of agricultural enterprises of the Steppe zone of Ukraine was carried out by an integrated method with their division into clusters based on the Euclidean distance method. The financial security potential for a group of enterprises is the sum of standardized coefficients for each indicator parameter, which has a distance from 0.79 to 3.62 and is divided into five clusters (Table 4).

Table 4: Clustering of agricultural enterprises of the Steppe zone of Ukraine according to the potential of financial security

Clusters	Share of cluster enterprises in total, %	Average value of standardized indicators by clusters					Sum of standardized indicators (financial security potential)
		Profitability on assets	Debt ratio	Adequacy of financing of illiquid assets	Asset turnover	Maneuverability of current assets	
I	2.08	0.25	0.15	0.30	0.20	0.21	1.11
II	14.58	0.45	0.46	0.29	0.18	0.36	1.74
III	33.33	0.51	0.72	0.35	0.15	0.50	2.23
IV	42.82	0.58	0.86	0.40	0.21	0.67	2.72
V	7.18	0.72	0.92	0.55	0.32	0.73	3.24

According to the sum of squares of deviations of indicators for each cluster from the sample average, intra-cluster and aggregate variance (potential of financial security of agricultural enterprises) was determined, with the distribution of indicators of financial condition and stable development into three groups (Table 5). The first group is the threshold criteria that have slight deviations from the reference level of financial condition. The second group – relatively significant indicators, which include eight criteria, according to which the difference in the amount of intracluster variance is 30-40% less than the total variance. The third group – significant criteria, which include the ten most influential indicators of financial security.

Table 5: Analysis of variance in clustering of agricultural enterprises of the Steppe zone of Ukraine by systemic factors of financial security

Indicators	Dispersion of indicators		Deviation	
	by clusters	by aggregate	+,-	%
Financial stability ratio	14.0	33.2	19.1	57.6
Investment ratio	583.9	929.3	345.4	37.2
Coverage ratio	3409.6	5846.7	2437.3	41.7
Rapid solvency ratio	404.0	620.8	216.8	34.9
Inventory coverage ratio	2364.9	3676.5	1311.6	35.9
Ratio of provision of fixed assets with working capital	405.2	639.0	233.8	36.6
Share of retained earnings in liabilities, %	13.4	26.9	13.5	50.1
Share of short-term debt in liabilities	13.8	33.0	19.2	58.1
Share of operating income in income	12.4	18.6	6.2	33.4
Share of net profit in income	12.8	21.8	9.0	41.2
Profitability of operating activities, %	9.4	15.0	5.6	37.4
Profitability of economic activity, %	9.2	16.9	7.7	45.7
Profitability of fixed assets, %	80.0	134.8	54.8	40.6
Provision per 1 hectare of agricultural land, thousand USD:				
- borrowed capital	74.2	107.3	33.1	30.8
- short-term loans	43.9	65.7	21.8	33.2
- working capital	90.4	179.4	89.0	49.6
Per 1 ha of agricultural land, thousand USD:				
- operating profit	14.8	26.4	11.6	44.0
- net profit	13.4	27.0	13.6	50.4

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The set of threshold criteria for the three groups (18 criteria) allowed to predict 7 important ones, which allow to stabilize the level of financial security and functionality of the economic process of agricultural enterprises (Table 6). To predict the integrated level of financial security of agricultural enterprises of the Steppe zone, a multiplicative function (23) was used, its value is a number from the interval [0, 1]. The higher the value B_t, the more stable the financial condition of enterprises (characterized by a higher level of financial security).

Table 6: Forecast normalized values of indicators that characterize the level of financial security of agricultural enterprises of the Steppe zone of Ukraine

Indicator number (t)	u_{t1}	u_{t2}	u_{t3}	u_{t4}	u_{t5}	u_{t6}	u_{t7}	Forecast of the integrated level of financial security, B_t
1	0.8611	0.8750	0.8521	1.0000	1.0000	0.3860	0.4394	0.1089
2	0.6944	1.0000	0.8170	1.0000	0.9780	0.5545	0.4451	0.1369
3	0.8889	0.8125	0.7043	0.9908	0.9780	0.3496	0.6818	0.1175
4	1.0000	0.8438	0.7477	0.9908	0.9780	0.5842	0.7519	0.2685
5	0.8056	0.8750	0.6057	0.9908	0.9610	0.7945	0.9905	0.3199
6	0.7500	0.9844	0.7878	0.9908	0.9780	1.0000	0.8371	0.4718
7	0.8611	0.8438	0.9236	0.9259	0.8776	0.4396	0.7595	0.1820
8	0.8333	0.7500	0.8246	0.9259	0.8888	0.7041	0.8201	0.2449
9	0.7778	0.8125	0.8739	0.9259	0.8849	0.5964	0.9867	0.2663
10	0.7222	0.9063	0.7962	0.9259	0.8961	0.6320	0.9034	0.2468
11	0.8056	0.8281	0.8037	0.8980	0.8698	0.5019	1.0000	0.2102
12	0.7500	0.8438	0.6583	0.8980	0.8810	0.6597	0.7803	0.1697
13	0.8056	0.7969	0.8647	0.8980	0.8839	0.4825	0.8883	0.1888
14	0.8056	0.8906	0.8956	0.8980	0.8976	0.6588	0.6951	0.2372
15	0.8611	0.7969	0.9683	0.8697	0.8683	0.5614	0.5398	0.1520
16	0.7778	0.7500	0.9474	0.8697	0.8898	0.5670	0.5303	0.1286
17	0.7222	0.9219	1.0000	0.8697	0.9039	0.5617	0.5644	0.1659
18	0.8333	0.9531	0.8246	0.8697	0.9127	0.7813	0.6231	0.2531
$\max\limits_{t\in[1,T]} v_{ti}$	0.8035	0.9697	0.7519	0.8476	0.9167	0.9068	0.6620	0.2733

The choice of the "best" predicted model of systemic factors of financial security is made based on the values of the coefficient of determination. The best polynomial models look like:

$$\tilde{u}_{t1} = 0.671002 + 0.072959t - 0.010537t^2 + 0.000564t^3 - 0.000010t^4;$$

$$\tilde{u}_{t2} = 0.827996 + 0.031224t - 0.004522t^2 + 0.000160t^3;$$

$$\tilde{u}_{t3} = 0.619719 + 0.030863t + 0.006400t^2 - 0.001896t^3 + 0.000145t^4 - 0.000003t^5;$$

$$\tilde{u}_{t4} = 1.026147 - 0.008501t;$$

$$\tilde{u}_{t5} = 0.968386 + 0.027777t - 0.007036t^2 + 0.000448t^3 - 0.000009t^4;$$

$$\tilde{u}_{t6} = 0.314741 + 0.040979t + 0.007288t^2 - 0.001151t^3 + 0.000037t^4;$$

$$\tilde{u}_{t7} = 0.392985 - 0.040300t + 0.029750t^2 - 0.002693t^3 + 0.000067t^4.$$

Forecast normalized values of indicators that characterize the level of financial security of enterprises have the following values:

$$\tilde{u}_{18(1)} = 0.671002 + 0.072959 \times 18 - 0.010537 \times 18^2 + 0.000564 \times 18^3 - -0.000010 \times 18^4 = 0.8035;$$

$$\tilde{u}_{18(2)} = 0.827996 + 0.031224 \times 18 - 0.004522 \times 18^2 + 0.000160 \times 18^3 = 0.9697;$$

$$\tilde{u}_{18(3)} = 0.619719 + 0.030863 \times 18 + 0.006400 \times 18^2 - 0.001896 \times 18^3 + 0.000145 \times 18^4 - -0.000003 \times 18^5 = 0.7519;$$

$$\tilde{u}_{18(4)} = 1.026147 - 0.008501 \times 18 = 0.8476;$$

$$\tilde{u}_{18(5)} = 0.968386 + 0.027777 \times 18 - 0.007036 \times 18^2 + 0.000448 \times 18^3 - -0.000009 \times 18^4 = 0.9167$$;

$$\tilde{u}_{18(6)} = 0.314741 + 0.040979 \times 18 + 0.007288 \times 18^2 - 0.001151 \times 18^3 + +0.000037 \times 18^4 = 0.9068$$;

$$\tilde{u}_{18(7)} = 0.392985 - 0.040300 \times 18 + 0.029750 \times 18^2 - 0.002693 \times 18^3 + +0.000067 \times 18^4 = 0.6620$$.

The forecast value of the integrated level of financial security of agricultural enterprises in the short term will be equal to:

$$B_{18} = 0.8035 \times 0.9697 \times 0.7519 \times 0.8476 \times 0.9167 \times 0.9068 \times 0.6620 = 0.2733$$

We should note that the forecast value of the integrated indicator is higher than several previous ones, which indicates a tendency to increase the level of financial security of enterprises in the Steppe zone of Ukraine. This is facilitated by the accelerated growth of accounts payable, equity and profits. Tendencies to reduce the value of fixed assets and income will have a negative impact on the potential of financial security. Graphic interpretation of the forecast change in the integrated level of financial security of agricultural enterprises for 2020-2024 is shown in Fig. 5.

Figure 5: Graphic interpretation of the dynamics of the level of financial security of agricultural enterprises of the Steppe zone of Ukraine
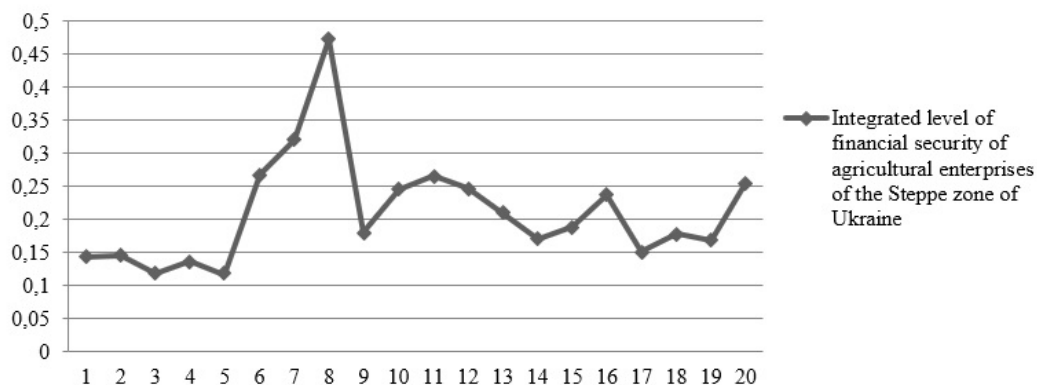
Thus, the process of ensuring the financial security of agricultural entities faces the need to radically reconsider the key interests of agricultural enterprises on the formation of the necessary and reproducible level of financial support, which should justify the implementation of functional elements of financial condition and protection of effective activities from internal and external threats.

4. Conclusions

Stable functioning of agricultural enterprises is impossible without forecasting trends in their economic development, because factors such as changes in the international market, declining production, inflation, and the dynamics of non-payment are increasingly becoming decisive. Therefore, ensuring financial security and stable development of economic entities in agriculture of Ukraine should be based on adequate financial policy, the availability of the necessary financial and credit institutions, the use of means, methods and techniques to ensure it. This should take into account the irreversible, directed and natural change in agricultural development, which results in a new qualitative state of the economic process and a viable cycle of financial security potential of agricultural enterprises.

Systematization of stimulating factors of financial security should be formed on the platform of agrarian policy mechanisms of the state support of the industry in favor of the development of competitive entrepreneurship, support for greening and environmental protection measures; ensuring the scale of regional policy of advanced innovative development of financial, credit, social and engineering infrastructure; formation of

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regulatory measures for the formation and operation of enterprises; risk leveling, implementation of protection measures against external and internal threats; improving the efficiency of financial resources of producers, the formation of trends in their profits, maintaining financial balance, through the optimization of financial flows of financial security entities in the context of ensuring their dynamic and stable development.

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CENTRAL ASIA: DRIVERS, DYNAMICS AND PROSPECTS OF TRADE AND ECONOMIC COOPERATION

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Abstract

The following article is devoted to the analyses of condition and expansion of trade and economic cooperation in the Central Asian Region (CAR). The positive change in the region began with the coming to power of the second President of Uzbekistan that's why the country of Uzbekistan is the central object of analysis in the article. In fact, the reforms of partial deregulation of the economy and building beneficial cooperation in the region were initiated by the former President of the Republic of Uzbekistan I. Karimov. But it was Sh. Mirziyoyev who gave impetus to the warming of the international climate in Central Asia. The reassessment of the regional policy of the Republic of Uzbekistan is dictated by the interests of the development of the Uzbek economy in the frame of new geopolitical and geoeconomic conditions. Using the comparative potential of cross-national analysis, it was compared the dynamics of establishing relations, expanding trade and economic ties of Uzbekistan with Kazakhstan, Turkmenistan, Tajikistan and Kyrgyzstan. Within a year the establishment of interstate cooperation since 2016 has given effect in the sphere of economy and trade within. This result was possible due to the fact that other countries of the CAR realized the necessity of close diverse ties with their neighbours.

Keywords: trade turnover, regional cooperation, bilateral relations, international relation

JEL classification: D78, F02, F13, F15

1. Introduction

Over the past four years, Central Asia has undergone a significant transformation in regional politics. The establishment of interstate relations, the solution of issues of borders, water and disputed territories in the region immediately affect the state of economic and trade relations in Central Asia. The experience of the Central Asian states over the years of independence, especially over the past 3-4 years, proves the primacy of high politics over economic practice, which has always been characteristic of underdeveloped regions. Frequent meetings, telephone conversations of leaders and key figures are the reason for creation the necessary political condition to open the gates for economic flows (Arkhipova, 2020). But at

the same time, it can be expected that the "avalanche effect", the situation when these economic and trade flows, intensifying themselves, drive innovation and move political circles towards a more active dialogue and greater cooperation between the countries. The main motivator for establishing cooperation and an indicator of the dynamics of the growth of relations between the countries of the region is trade (Coufalová, 2018; Gubanova and Voroshilov, 2019; Martinho and Barandela, 2020).

To prove this hypothesis, we began our study with Uzbekistan. In 2019 "Financial Times" worthily gave the title the "Country of the year" to Uzbekistan with the title. Almost all experts agreed that it was this state that gave rise to cooperation and regionalization and that today it plays the role of a political and economic driver. But we suppose that after a quarter of a century of their independence, the states of the region, having gone through formation, having tested all kinds of options and formats for development, have matured for full-blooded relations with their neighbors in the region. Therefore, they were ready to support the initiative of the new President of the Republic of Uzbekistan to establish a regional cooperation and jointly build bridges for greater understanding, friendship and interaction. In this regard, we examined the state of relations of Uzbekistan with the other four states individually.

Pre-term election was held in Uzbekistan on December 4, 2016, where Sh. Mirziyoyev became the second Uzbek President. In early February 2017, Uzbekistan approved the Country Development Strategy for 2017-2021, which focuses the country's foreign policy on creation of security belt, stability and good neighborliness around Uzbekistan. Sh. Mirziyoyev declared the Central Asian region as the main priority of foreign policy of Uzbekistan's activities. The country's main national interests are connected with the Central Asian Region (CAR). President Sh. Mirziyoyev confirmed the priority of Central Asia by the fact of his first meeting with the Head of Kyrgyzstan A. Atambayev, and his first visits to Turkmenistan and Kazakhstan, the neighboring states of the Republic of Uzbekistan. The Concept of Foreign Policy of Uzbekistan activities accepted under I. Karimov, defined Central Asia as major foreign policy priority of the country activities. Is it a tribute to succession to traditional policy or there are some deeper reasons for the politics of Uzbekistan?

The new leader of the Republic of Uzbekistan outlined five prospects that formed the basis of his program for 2017-2021, as well as the concept of reforming the legal, law and administrative systems, deregulation of the economy and the development of the social sphere. In particular, Sh. Mirziyoyev outlined five major sectors that will become the drivers of the country's economic growth until 2021. This is textile industry, production of industrial building materials, fruit and vegetable sector, pharmaceuticals and tourism. The development and deregulation of the economy also provides reduction in the tax burden, simplification of the tax system, and development of international cooperation (Engin Duran and Pelin Özkan, 2015). The strategy involves increasing the competitiveness of the national economy. And the main steps of economic reform in Uzbekistan have already been taken. So, Sh. Mirziyoyev signed decrees on lifting of restrictions on companies to supply goods to the foreign market without an export contract (Russian business, 2018).

After coming to power, the new President was noted by a series of promising initiatives and statements that forced observers to use the words "thaw" and "liberalization". But expert circles are restrained in their assessments of the processes taking place in Uzbekistan. At the same time, the principle and scale of the nature of the ongoing innovations should be recognized, judging by their results and the impact on the country itself and its environment. As is commonly known, I. Karimov made attempts to weaken strict state control and partial liberalization. In July 2012, a set of measures was taken to reduce control, simplify licensing and streamline permits. In order to improve the investment climate in Uzbekistan, President I. Karimov signed several legislative amendments on January 20, 2014, allowing foreign investors certain preferences for attracting foreign labor and obtaining multiple visas for their international employees, as well as providing more guarantees from the state to create the necessary infrastructure and investment protection. In addition, in January 2015, the first President gave specific instructions for the government to focus on improving the country's rating as part of the World Bank's Doing Business. He also instructed the government to reduce state ownership in several sectors and implement a new program of privatization of

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state assets for 2015-2016, in addition to the program for the development of industrialization and modernization of infrastructure, launched in 2011-2015.

In order to improve the trade and investment climate in Uzbekistan, President I. Karimov began to implement some measures to simplify customs procedures. These measures included a significant reduction and simplification of customs documents, the creation of a common electronic database at the interdepartmental level, and the deregistration of import contracts. Separate attempts have been made to promote civil society, such as law on transparency and accountability of state bodies and legislation on social partnership. All these measures were scattered in time and in content, there was no firm, concentrated policy behind them, therefore, they had no tangible, multiplicative effects, and remained largely at the level of the declaration.

In our opinion, the main drawback of the planned measures in 2012-2016 was the lack of a regional projection of the innovations being adopted, as if the country was in a different dimension than the neighboring countries. Sh. Mirziyoyev, unlike the former President, recognized the paramount importance of constructive trade and economic cooperation with Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan for building the economic potential of the Republic of Uzbekistan. The regional policy of the President of Uzbekistan proceeds from the resource, transport and logistics, trade significance of the neighbors in the region in the context of changes in the global economic situation. "The experts note several factors that influenced the change in Tashkent's policy. These include a fall in world commodity prices and a slowdown in economic growth in Russia and China, which are the main economic partners of Uzbekistan. As a result, the republic has faced a significant drop in external demand and a decrease in income from the sale of its main export commodities – gold, cotton and gas. In addition, the entry into force of the Eurasian Economic Union negatively affected the state of certain sectors of the economy of Uzbekistan due to newly arising barriers to trade with countries participating in this union" (Laumullin, 2020). It is necessary to emphasize that S. Mirziyoyev initially assigned a decisive role to inter-regional, cross-border cooperation in his Central Asian policy. It was he who proposed creating the Association of Heads of Border Regions of the Central Asian Countries, convening a forum of interregional cooperation between Uzbekistan and Kazakhstan. Thus, the main goal of this study is to analyses of condition and expansion of trade and economic cooperation in the Central Asian region.

2. **Materials and Methods**

To study the topic under consideration, we mainly used cross-national analysis, which emphasizes national states as the main object of analysis. The current state of world politics suggests that the course of world development is fixing on states, despite the triumphal march of globalization over the past few decades. As it turned out the theorists who wrote about the "return" of classical international relations were right (Karjoo and Sameti, 2015). Today the superpowers again have embarked on a race in the political and military spheres and the geopolitical tensions in the world have intensified, medium and small states find themselves in a cramped international environment with a reduced set of options for conducting their own policies. In this context, these states are forced to seek new patterns of behavior or to compromise with what they underestimated and leveled (Napolskikh and Yalyalieva, 2019). The Central Asian states, torn by the external factors, were as far apart as possible, ignoring the potential of good neighborly relations. It is difficult to say whether they reached a peak in their remoteness from neighbors in the region, but it was the impact of exogenous influences (cheaper energy, all types of raw materials, global market environment, a new round of geopolitical outfit and conflict in the world) that created the conditions for their turn towards their region (Sakamoto, 2012).

At the same time, one must pay tribute to the theoretical concepts of "neoclassical realism", which seeks motivation for international behavior within the society and state itself (Stilianos et al., 2010). We hope that the need for changes in relations with neighbors has arisen not only in the highest echelons of power, but also in wide sections of society where businessmen and public figures realize the need for close economic cooperation with neighbors (Batabyal and Beladi, 2016). Using the comparative potential of cross-national

analysis, we compared the dynamics of establishing relations, expanding trade and economic ties of Uzbekistan with Kazakhstan, Turkmenistan, Tajikistan and Kyrgyzstan.

3.   Results and Discussion

3.1. Kazakhstan-Uzbekistan relations: analysis of trade and economic cooperation

The key foreign policy achievement of Sh. Mirziyoyev in regional policy is improvement of the attitude with Kazakhstan. It is natural that his second visit as the President he made to Kazakhstan (and earlier it was even planned that this would be the first visit). In comparison with other countries of Central Asia Kazakh-Uzbek relations were not strongly dragged by sharp disagreements and conflicts. There was no sharp decline in trade relations and a break in political dialogue. The border issues between the states were relatively painless and resolved (not taking into account, of course, the cases of shooting and deaths at the border). In September 9, 2002, in Kazakhstan, the President of Kazakhstan N. Nazarbayev and the President of Uzbekistan I. Karimov signed an agreement between Kazakhstan and Uzbekistan on separate sections of the Kazakh-Uzbek border.

The state border between Kazakhstan and Uzbekistan was recognized under the Commonwealth of Independent States (CIS) Treaty. The village of Bagys and the Arnasay dam with five settlements that previously belonged to Uzbekistan, were transferred to Kazakhstan under a concluded agreement. The village of Turkestanets, previously owned by Kazakhstan, was transferred to Uzbekistan under the agreement. It was emphasized that if the residents of the village of Turkestanets wish to move to Kazakhstan, they will be given the status of oralmans. It was stated from high tribunes that "the completion of the process of legal description of the state border is an important historical event that completely removes the issue of disputed sections between Kazakhstan and Uzbekistan" (Sputnik, 2017). In 2003 the process of demarcation, which ended within a year without any excesses has begun.

In comparison with other countries of the Central Asia Region, the Presidents of the Republic of Kazakhstan and the Republic of Uzbekistan met, although not often, but regularly, and there were no long disagreements between them. The interests of Kazakhstan and Uzbekistan coincided on the main points of the so-called "water problem" of the Central Asian region. The policies of Kyrgyzstan and Tajikistan, locating at the source of the region's main rivers and using "water levers" on their neighbors brought together the positions of Kazakhstan and Uzbekistan in resolving this issue. Although trade and economic relations between Uzbekistan and Kazakhstan in the period from the 1990s to the mid-2000s were at a relatively low level for a number of objective and subjective reasons, in terms of volume they were the most extensive in the region. But when in April 2008, during the visit of the President of Uzbekistan to Astana, I. Karimov and N. Nazarbayev signed the "Agreement on the Establishment of a Free Trade Area between Uzbekistan and Kazakhstan" in subsequent years, the volume of foreign trade between the countries increased significantly.

According to the Uzbek specialist Mirzokhid Rakhimov (2016), in 2012 it amounted to more than $2.5 billion, with exports from Kazakhstan to Uzbekistan amounting to $1.344 billion, and imports from Uzbekistan to Kazakhstan – $817 million. In 2015, trade between countries exceeded to 3.2 billion US dollars. One of the key areas of cooperation between the two countries was transit and the supply of goods from Uzbekistan to Russia through Kazakhstan or from Kazakhstan to various Asian countries through Uzbekistan (Kozhevnikov, 2020). In 2015, the transit of Uzbek goods through the territory of Kazakhstan amounted to more than 2 million tons, and the transit of Kazakh goods through the territory of Uzbekistan more than 3 million tons.

The joint intergovernmental commission on bilateral cooperation between Uzbekistan and Kazakhstan, which can be considered on the institutional basis for establishing ties between the two countries, worked regularly, monitoring and developing a dialogue on pressing issues. As it turned out in 2008-2015, Kazakhstan and Uzbekistan were not far from a real trade, economic and political partnership. But they were far from creating an integration association, union. In April 2008, during the visit of I. Karimov to Astana, N. Nazarbayev put forward the idea of creating a union of Central Asian states. The President of Uzbekistan did not accept this idea, motivating it by the fact that the economies of the states of the region are diverse, and regional integration can cause even greater damage to the economies of Central Asian

countries. The non-closure of I. Karimov's initiatives of the Republic of Kazakhstan on integration into the Central Asian Region by expert circles is generally regarded as a manifestation of competition for leadership in the region. (Although I. Karimov himself took the initiative in 2006 to create a common market for the region, which was not heard by others. Also, in September of the same year he took part in an informal meeting of the Central Asian Heads of State in Astana). But the "theory of leadership" in the CAR was no good at all, as there was no real basis for rivalry between the two countries. As Kazakhstani expert D. Satpayev said: "In fact, it was sucked out of the finger. There was no competition. Uzbekistan under Islam Karimov and Kazakhstan showed different development models – both economic and political. Under Karimov, Uzbekistan was "fixed" on itself, was a bit in a state of isolation. When it comes to economic development, Kazakhstan was considered a "favorite", but precisely in terms of attracting investment. I believe that competition will begin right now, when Shavkat Mirziyoyev very abruptly begins to change both the foreign policy of Uzbekistan and domestic economic policy" (Sputnik, 2018).

Naturally, what the Heads of states were aware or what were their perceptions of reality important for the analysis of interstate relations. I. Karimov has repeatedly stated the continuity of statehood of modern Uzbekistan and the state of the Timurids, whose power, as is known, extended at one time to most of Central Asia. Moreover, many foreign experts in the 90s saw Uzbekistan as a potential leader in international processes in the Central Asian Region, and such expectations and the attitude based on them could be the reason for some understatement, coolness between the Presidents of the Republic of Kazakhstan and the Republic of Uzbekistan, but not be a serious basis for the discrepancy on fundamental issues of regional policy. They were warmed up by the existing problems of bilateral relations, which, as it seemed, could not be solved any way. For example, the stumbling block in the disagreements between Kazakhstan and Uzbekistan was the fact that both of these countries take water from the Syr Darya river to the detriment of each other's agricultural land (according to unofficial data, in the Maktaaral district of the South Kazakhstan region alone, about 30 percent of the land ceased to be used for sowing various crops and, first of all, cotton, due to water intake by Uzbekistan).

As it was mentioned above, on March 23, 2017, Sh. Mirziyoyev, as the newly elected President, paid his second official visit to Kazakhstan. As a result, Shavkat Mirziyoyev and Nursultan Nazarbayev signed a Joint Declaration on further deepening the strategic partnership and strengthening good neighborliness between the Republic of Uzbekistan and the Republic of Kazakhstan. In its content, the signing of the "Strategy for Economic Cooperation between the Republic of Uzbekistan and the Republic of Kazakhstan for 2017-2019" and the "Agreement between the Republic of Uzbekistan and the Republic of Kazakhstan on Interregional Cooperation" was of particular importance (Official Site of the President..., 2017). In September 2017, the President of Kazakhstan N. Nazarbayev paid a return visit to Tashkent. Following the meeting of the Presidents of the Republic of Kazakhstan and the Republic of Uzbekistan, it was decided to hold the Year of Uzbekistan in Kazakhstan in 2018, and the Year of Kazakhstan in 2019 in Uzbekistan. Important documents have been adopted that serve as the basis for direct contacts between the regions of the two countries. Memoranda of cooperation in trade, economic, cultural and humanitarian spheres were signed between the khokimiyats of the Syr Darya and Tashkent regions and the akimat of the South Kazakhstan region, the khokimiyat of Navoi region and the akimat of Kyzylorda region (Khairzoda, 2018).

In order to develop cross-border trade and simplify export procedures in Uzbekistan, it is allowed to export goods (excluding raw materials), work and services without concluding an export contract, after making 100% prepayment to the accounts of exporters in banks of Uzbekistan, by invoice. Some visa and transit restrictions were lifted. It is from 2017 that the intensification of Kazakh-Uzbek trade and economic ties began, and trade between the two countries showed growth. The year 2018 was intense in terms of political dialogue and a breakthrough in trade and economic cooperation between the two countries. The Presidents of Kazakhstan and Uzbekistan had a detailed conversation during a meeting of leaders of the Central Asian states on the eve of Nauryz in 2018. In November 2018, the first interregional Forum "Kazakhstan – Uzbekistan" was held in Shymkent. The forum was attended by the leaders of several regions of the two countries. Following the forum, the leaders of the regions

of the two countries signed 16 documents in the implementation of joint projects in priority sectors of the economy. The agreements were signed on the mutual recognition of visa regimes by the countries of the Silk Road, the creation of a joint venture between "KTZ Express" JSC and the "Uzavtotranstekhnika" JSC and Research and Production Center. Also, an agreement on the transportation of natural gas through the territory of Uzbekistan was signed between "KazTransGas" JSC and "Uztransgaz" JSC. With the holding of the forum, the tendency for the prevalence of interregional cooperation in bilateral relations between the Republic of Kazakhstan and the Republic of Uzbekistan was firmly established.

It is noteworthy that K. Tokayev, as the President elected by the people, paid his first foreign visit to Uzbekistan on April 15, 2019. The Presidents of Uzbekistan and Kazakhstan called 2018 a breakthrough year in the field of development of trade and economic cooperation, trade grew by 50% and exceeded $3 billion. "The parties reaffirmed their mutual desire to reach the level of $5 billion in the coming years, the intergovernmental commission on bilateral cooperation between Uzbekistan and Kazakhstan was set the task of expanding the range of trade relations, finding and developing new long-term forms of economic cooperation" (Regnum, 2019). K. Tokayev drew particular attention to the accelerated creation of a joint tourism cluster of the two countries. On July 17, 2019, the Heads of the governments of Kazakhstan and Uzbekistan opened Beineu – Akzhigit – a highway of international importance – the border of Uzbekistan. The road will open access for a shorter output of Uzbek goods to the markets of Russia and the countries of the Caucasus. According to the Consul General of Uzbekistan in Kazakhstan, Abror Fathullaev, according to the results of 2019, bilateral trade amounted to $3.3 billion (Exclusive, 2020). The Kazakhstan side provides data at the level of $4.1 billion in bilateral trade volume for 2019 (Figure 1) (Inbusiness.kz, 2020).

Figure 1. Indicators of trade between the Republic of Kazakhstan and the Republic of Uzbekistan for 2015-2019
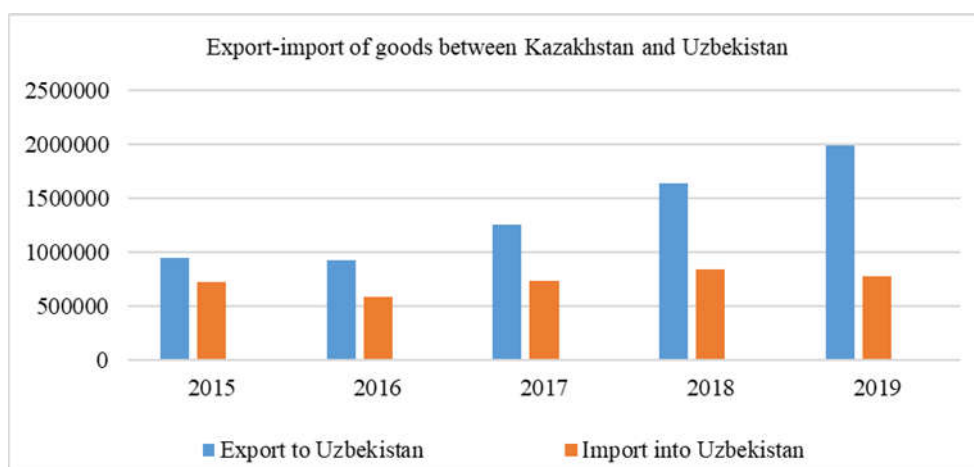
Source: Inbusiness.kz, 2020

On February 26, 2020, in the Uzbek city of Urgench, the second forum of inter-regional cooperation between the Republic of Kazakhstan and the Republic of Uzbekistan "Cooperation of regional business in the areas of agro-industrial cooperation, industry and tourism" was held. This forum brought together more than 300 people – the Heads of government agencies, regions, as well as representatives of business circles from two countries. In his speech at the forum, the Prime Minister of the Republic of Kazakhstan put forward initiatives to create a Kazakh-Uzbek cluster of light industry on the basis of the free-trade zone "Ontustik" in the city of Shymkent, to open a joint tourist route for tourist sites of Turkestan, Tashkent, Samarkand, Bukhara and Khorezm areas, the joint development of wholesale distribution and agro-logistics centers (Official Information Resource…, 2020). A business meeting was held in the B2B format with the participation of business circles of the two countries. The serious and constructive intentions to increase cooperation between the Republic of Kazakhstan and the Republic of Uzbekistan are confirmed by the preparatory work on the opening of the International Center for Trade and Economic Cooperation "Central Asia" on the border of Uzbekistan and Kazakhstan, which will contribute to the growth of cross-border trade, improvement of access control infrastructure, as well as the

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creation of Central Asian major trade and logistics hub. Specialists of the two countries are working closely to bring the positions of the parties closer and come to a common denominator in order to introduce a single SilkWay visa (2020) in the very near future.

3.2. Uzbekistan-Tajikistan relations: analysis of trade and economic cooperation

In almost all works on Central Asia, it is noted that the Uzbek-Tajik relations are axial and crucial for the region. Taking into consideration the fact that recently there were almost no communications between these countries and there were mined sections on the Uzbek-Tajik border in peacetime, the question of today's condition is particularly interesting. The interweaving and mutual influence of politics and the economy are clearly demonstrated on the ups and downs of trade and economic relations between Tajikistan and Uzbekistan since the moment of independence. In the 90s of the last century, trade relations constantly showed growth, reaching a maximum value of 445.4 million US dollars in 1999 (Melibayev, 2017). The subsequent decline in trade, starting in 2000, was the result of a deterioration of mutual understanding on security issues at the border, religious extremism, as a result of political instability, primarily in Tajikistan.

For many years, one of the sticking points in Tajik-Uzbek relations was the Tajik colonel, ethnic Uzbek Mahmud Khudoyberdyev. From 1996 to 1998, he rebelled three times against the government of Tajikistan, and then hid in Uzbekistan. The first rebellion was partially successful – then Tajik President Emomali Rahmon had to negotiate with the rebel colonel and even remove some of the ministers. The second rebellion was suppressed by the presidential guard, and Khudoyberdyev retreated with his supporters to the territory of Uzbekistan. From there, in 1998, Khudoyberdyev crossed the border with a thousand fighters in less than a day and captured the Tajik cities of Khujand, Chkalovsk and the strategic pass Shakhristan. For four days of fighting, government forces ousted Khudoyberdyev from the country. After Khudoyberdyev's flight, the Tajik authorities regularly turned to the leadership of Uzbekistan with a request to extradite the colonel. Official Tashkent replied several times that Khudoyberdyev died in a shootout with one of his associates. Later, the name of Khudoyberdyev was mentioned in connection with the dispersal of a peaceful protest in Andijan.

The Agreement on Eternal Friendship, signed in 2000, was essentially the result of inertia from the previous stage of cooperation; it could not have a practical impact on the situation. In the face of terrorist danger from the territory of Tajikistan, Uzbekistan has mined vast areas along the Uzbek-Tajik border. For a short time, the parties introduced a visa regime, interrupted direct flights between the countries. The first decade of the new 21st century was a period of decline in economic relations between the two countries in many respects. "For almost two decades, relations between Tashkent and Dushanbe have been mostly unfriendly. A significant contribution was made by personal hostility between Karimov and his Tajik counterpart Emomali Rahmon, but Tajikistan's efforts to build the Rogun dam, which promised to completely change the status quo, also played a role in the field of water use, which irritated the Uzbek side" (Persing, 2018).

After a demonstration of commitment to "hyper-security" in the interest of maintaining existing regimes, by the end of the first decade of the new century, the countries are entering a new round of confrontation over water resources (first the construction of the Sangtuda-2 hydroelectric power station by Tajikistan, then the Rogun hydroelectric station) using tough water methods and gas diplomacy. The result was not long: in 2011, the volume of exports of goods from Uzbekistan to Tajikistan has the lowest level compared to the volumes of exports to other countries of Central Asia. Also, the volume of imports of goods from Tajikistan to Uzbekistan has the lowest level in comparison with the volume of imports from other countries of Central Asia. Tajikistan, which occupied first place in the export trade of Uzbekistan in the region, was thus in the last place (Ganiyev and Yusupov, 2012).

Stagnation in economic relations between the two countries continued until 2016. The new political round of the Tajik-Uzbek dialogue, which began in the fall of 2016, became the necessary political basis for the restoration of economic cooperation. On September 29, 2016, the President of Tajikistan received the Minister of Foreign Affairs of Uzbekistan, who arrived in Dushanbe on a working visit. The Foreign Minister of Uzbekistan conveyed an oral

message from acting President Shavkat Mirziyoyev to his Tajik counterpart and spoke about Tashkent's readiness to restore economic cooperation with Tajikistan, and to resume railway and air communications. After that, several government delegations and commissions from both sides visited Dushanbe and Tashkent to discuss demarcation of borders, the resumption of rail and air services, simplifying the procedure for obtaining visas and mitigating the entire process of border crossing at checkpoints and a number of issues in the field of economic cooperation.

To enhance trade and economic relations, in April 2017, the National Exhibition of Products of Uzbekistan was first held in Dushanbe. More than 160 companies and more than 400 entrepreneurs from the Uzbek side presented more than 1.5 thousand types of products, including new products from domestic electrical engineering, pharmaceuticals, perfumes, leather and footwear, chemical, food, textile industries, agricultural machinery, cars and trucks, buses, building materials, elevators, household appliances, furniture and other goods. The return exhibition was held in October 2017 in Tashkent. It was attended by representatives of more than 150 companies and entrepreneurs of Tajikistan, leading activities in such fields as oil and gas, construction, transport, minerals, pharmacology, light, processing and agricultural industries, healthcare, education, science and technology, tourism.

The holding of these exhibitions and business forums has served to unite efforts with Tajik partners to promote the products of the two countries on the world market. As part of the exhibitions in Tashkent and Dushanbe, trade agreements were signed for a total value of more than $100 million. In the same year, air and rail links between the countries were opened, the A-377 international road on the Samarkand-Penjikent section began its work. The checkpoints on the Uzbek-Tajik state border have resumed work. In the short term, these measures quickly spurred trade relations. According to the results of 2017, the volume of trade between the Republic of Uzbekistan and the Republic of Tajikistan was 20.2 percent more than in 2016 (Tajik Technical University…, 2018).

The reasons for establishing economic and diplomatic relations in the Central Asian Region, including Uzbekistan and Tajikistan in the scientific literature, are explained by diverse factors, among which the main role is played by political ones. If we remember the high degree of personification of policies in Central Asian states, the role of political will cannot really be overestimated in processes in the region. At the same time, it was time for the leaders of the states to understand and accept the fact that in addition to subjective factors, there are urgent tasks of a socio-economic nature, which in principle cannot be solved without taking into account the closest neighbors. According to Tajik expert K. Abdullayev for Tajikistan, "completely dependent on Uzbekistan in terms of transport communications, without deposits of such important minerals as gas and oil, the most promising survival strategy is to maximize integration into the Central Asian (even Turkic) community. It is Uzbekistan that can and has the chance to act as a driver of regional integration. This is perfectly understood in Dushanbe, especially against the backdrop of a weakening of Russia, "bogged down" in the unequal confrontation with the West, as well as the growing role of China (Stratakis and Pelagidis, 2020). The Uzbek vector is the most promising and probable for Tajikistan today. On the other hand, rapprochement with Tajikistan, the closest neighbor to the chronically unstable Afghanistan, is also a desirable path for Uzbekistan if it intends to become a prosperous and safe Central Asian snow leopard" (K-News, 2019).

The role of the water and energy factor as a driver in economic cooperation between the countries is significant. The issue of building the Rogun hydropower station spoiled relations between Uzbeks and Tajiks for a long time and decades Tajikistan needed to start its construction. The construction process, which began in 2016, served as a trigger for establishing relations between the states. The state visit made by the President of Uzbekistan Shavkat Mirziyoyev to Tajikistan in March 2018 has truly become a historic one. Having extended the first hand of friendship to a neighboring country, Mirziyoyev once again proved that it was Uzbekistan who initiated regional cooperation. As a result of this visit, 27 documents on bilateral cooperation were signed, including an agreement on visa-free travel for up to 30 days. The Presidents of the two countries consider this document the beginning of the degeneration of Tajik-Uzbek relations. The Heads of the states attended the opening ceremony of "the Galaba-Amuzang-Khushadi" railway line connecting the Surkhandarya region of Uzbekistan with the Khatlon region of Tajikistan. The Presidents pressed a symbolic

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button, thereby giving an official start not only to railway communication, but also to a new stage in relations between the two countries (Official Site of the Ministry…, 2018).

The political will of the President of the Republic of Uzbekistan for cooperation was supported by the Head of Tajikistan, Emomali Rahmon, who arrived on a return state visit to Uzbekistan in August 2018. It should be emphasized that the last time he visited Uzbekistan twenty years ago, in 1998. Following the talks, Shavkat Mirziyoyev and Emomali Rahmon signed a Strategic Partnership Agreement between the Republic of Uzbekistan and the Republic of Tajikistan, which defines the goals of establishing long-term and sustainable partnership relations, strategic directions of bilateral cooperation. 27 documents were signed regarding cooperation in industry, standardization and certification, intersection borders, recognition of documents on education, geodesy and geology, agriculture, culture and other fields. More than 60 large industrial enterprises of the country took part in the exhibition organized at "the Uzexpocenter" and demonstrated the products of Tajikistan produced under the slogan "Made in Tajikistan" (Radio Azattyk, 2018). 2018 in the Republic of Tajikistan was declared the Year of Tourism and Folk Crafts. In this regard, at a meeting of the Heads of the states of Tajikistan and Uzbekistan, a great interest was expressed in the development of tourism between neighboring countries. An Agreement was adopted between the Government of the Republic of Tajikistan and the Government of the Republic of Uzbekistan on cooperation in the field of tourism (Khairzoda, 2018). As a result of such measures, 2018 was a breakthrough year in all directions, primarily in the tourism sector. By the number of Uzbeks who visited Tajikistan and Tajiks in recent years, this year was a record year (Figures 2-3).

Figure 2. The number of citizens of the Republic of Uzbekistan who left for the Republic of Tajikistan
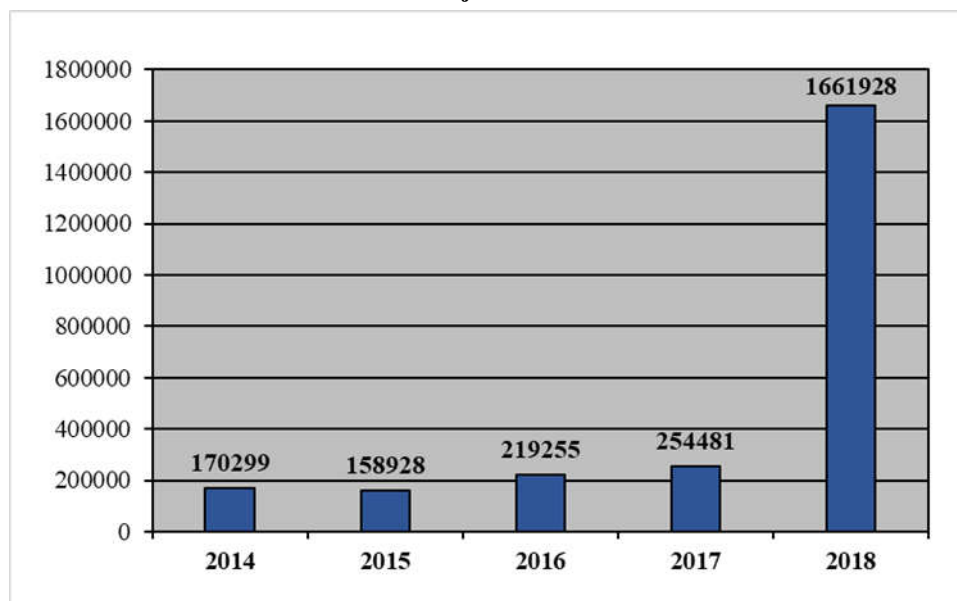
Source: State Committee of the Republic of Uzbekistan on Statistics, 2020

Figure 3. The number of citizens of the Republic of Tajikistan who left for the Republic of Uzbekistan
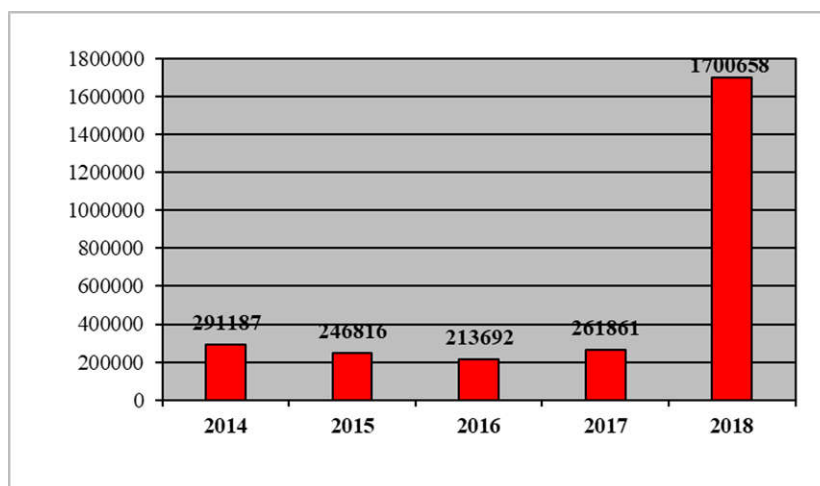
Source: State Committee of the Republic of Uzbekistan on Statistics, 2020

Improving the international climate in the region, investments, PR strategies have paid off. According to AFAR Travel Magazine, there has been an increase in the flow of tourists in Tajikistan: there were 431 thousand in 2017, and a year later, in 2018, already 1.25 million (BBC News, 2019). The multiplier effect of the whole complex of measures for establishing bilateral cooperation had a positive effect on trade (Figures 4-5).

Figure 4. The dynamics of trade between the Republic of Uzbekistan and the Republic of Tajikistan for 2014-18

Source: Khairzoda, 2018

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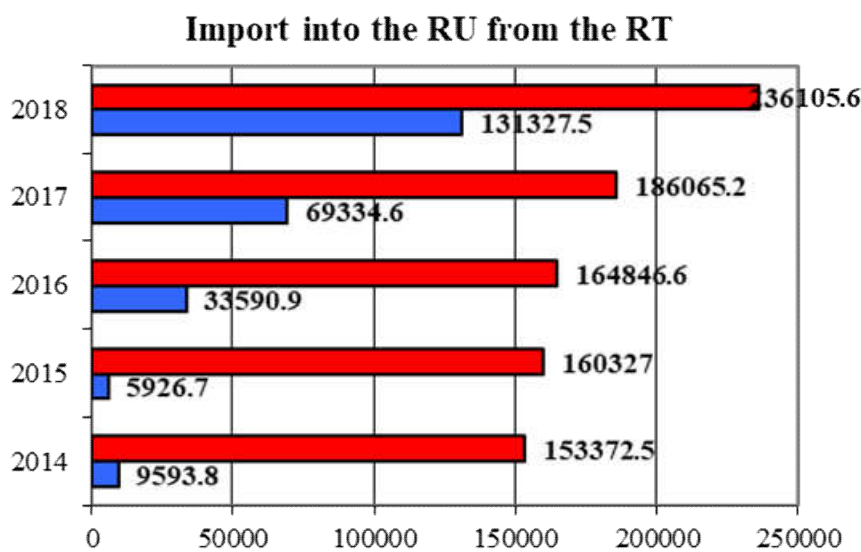
Figure 4. The dynamics of trade between the Republic of Uzbekistan and the Republic of Tajikistan for 2014-18

Source: Khairzoda, 2018
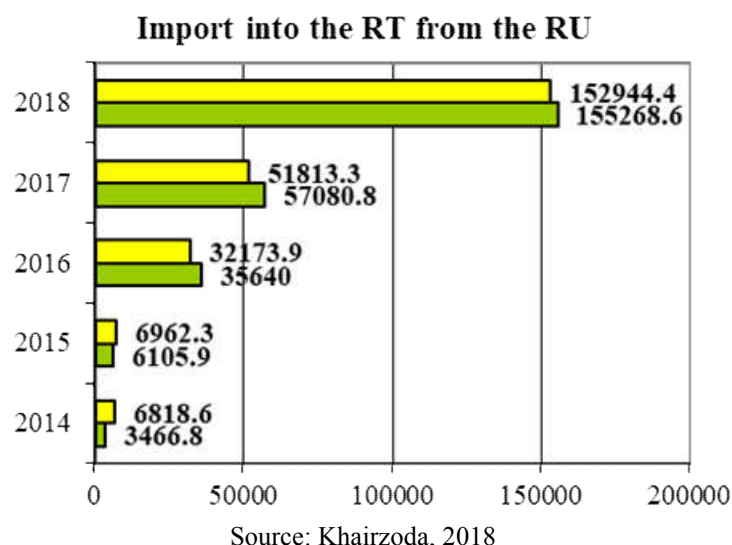
As it was mentioned above, the water-energy factor plays a decisive role in bilateral relations (Hamm, 2013). A key event in Tajikistan was the launch of the second Rogun unit in September 2019. The country is steadily making every effort to complete the construction of this hydraulic structure, which in the near future can turn the country into a major producer of cheap and environmentally friendly electricity in the region (Sitarov and Urekeshova, 2017). Also, Uzbekistan, with its growing economic needs, can benefit from the full launch of the Rogun hydroelectric station, becoming one of the main consumers of cheap, low-cost electricity. Also, Uzbekistan, according to Vladimir Paramonov, the Head of the Central Eurasia analytical group: "In my opinion, neither the nuclear power plant construction project nor solar power plant construction project will affect the growing needs of Uzbekistan for cheap energy, the generation of which is possible only at the hydroelectric power station. Diversification and a combination of different sources of electricity generation is the right path to development" (Krivosheev, 2018). Therefore, the water and energy sector may be the guarantor of the continuation of the policy of building up cooperation, supported by both sides (Belyakova and Vorobyeva, 2018).

3.3. Uzbekistan-Turkmenistan relations: analysis of trade and economic cooperation

Economic pragmatism initially supported relations between Uzbekistan and Turkmenistan, preventing the differences from escalating to critical levels. Compared with Tajikistan and Kyrgyzstan, with Turkmenistan, Uzbekistan had established trade and economic relations and they did not experience sharp confrontations over the years of independent existence, with the exception of the first decade of the 21st century. Relations between the countries were spoiled by the alleged assassination attempt on Turkmenbashi on November 25, 2002, in the organization of which the Turkmen authorities accused Boris Shikhmuradov, the former Head of the Turkmen Foreign Ministry. Ashkhabad accused the authorities of Uzbekistan, showing some evidence that the main "suspect" Shikhmuradov secretly entered Turkmenistan from the territory of Uzbekistan. This was followed by a diplomatic scandal when representatives of the Turkmen special services searched the Uzbek embassy and the ambassador was expelled from the country.

But countries established relations relatively quickly. Prospects for joint transportation of gas to a new marke – to China and the five-sided agreement between Uzbekistan, Turkmenistan, Iran, Oman and Qatar to form a new international transport corridor "Central Asia – Middle East" pushed the countries to seek a compromise in relations. Transport corridors, where Uzbekistan would gain access to the sea, and Turkmenistan – access to China, became weighty arguments for both sides, so as not to focus on negative experiences. "For Uzbekistan, Turkmenistan is interesting in several keys. Uzbekistan and Turkmenistan

are well connected by road and rail, which makes it possible to plan joint transport projects in all three areas: Central Asia and Europe, Central Asia and the Caucasus and the Middle East, Central Asia and China. Connecting to transit and transport corridors is a vital need for commodity-oriented economies. The implementation of the "Turkmenistan-Uzbekistan-Kazakhstan-China" gas pipeline project, commissioned in 2009, was a good experience in the two countries' interaction in diversifying energy transportation routes. The summits took place on such a wave of mutual understanding. The President of Uzbekistan Islam Karimov visited Turkmenistan in 2012 and 2014. Other Central Asian countries, except Kazakhstan, did not receive the attention of the President of Uzbekistan, who was clearly supportive of his southern neighbor. The President of Turkmenistan Gurbanguly Berdimuhamedov paid a return visit to Tashkent in 2015. The reason was, first of all, the pragmatic questions of potential joint projects. The above-mentioned five-sided agreement between Uzbekistan, Turkmenistan, Iran, Oman and Qatar on the creation of an international transport and transit corridor was initiated in April 2011 in Ashgabat following the negotiations of the delegations of the participating countries.

Issues related to the implementation of the project were discussed at a meeting of the Heads of the foreign affairs agencies of these states on August 7, 2014 in Muscat, the capital of Oman. Following the talks, the parties signed a Memorandum of Understanding on the implementation of the Agreement between the governments of Iran, Oman, Qatar, Turkmenistan and Uzbekistan on the creation of an international transport and transit corridor. In February 2015, a meeting of the Coordination Council was held in Tehran under the agreement of this transport corridor with the participation of representatives of Iran, Uzbekistan, Turkmenistan and Oman. The Ashgabat agreement on the creation of an international transport and transit corridor between the governments of Iran, Oman, Turkmenistan and Uzbekistan entered into force in April 2016 (Sputnik, 2019). Thus, the discussion of the problems of this project has become a good platform for building up the Uzbek-Turkmen cooperation.

In this context, it was logical that Turkmenistan became the first country where the newly elected President of the Republic of Uzbekistan, Shavkat Mirziyoyev, made his first state visit in March 2017. The opening of the railway bridge through the Amu Daria river by the Heads of two states during his visit was really a symbolic event; the transit sphere has become the core of economic cooperation and political dialogue between countries. In 2017, the President of Uzbekistan made three visits to Turkmenistan, and 40 Uzbek delegations also visited this country during the indicated period. This fact indicates a rather high intensity of political dialogue and practical interaction between countries.

Another sign of trusting relations between the countries was the Turkmenistan invitation of the business circles of Uzbekistan to participate in the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline project. Uzbekistan was also invited to start developing oil and gas fields on the Turkmen shelf of the Caspian (the construction of the Turkmen section began in December 2015 from the Turkmen city of Mary and on February 23, 2018, the Afghan TAPI section was stratified). During the negotiations, the President of Uzbekistan during his visit to Turkmenistan in April 2018 announced the intention of the republic to take part in the construction of TAPI. Problems with financing this project are still holding back Uzbekistan from participating in the construction of the project. But in the long run, the growing needs and opportunities of the Uzbek economy can push political and business circles to become more active in this direction. In the same 2018, a new section of the railway between Turkmenistan and Afghanistan, Serhetabat-Turgundi was launched. Turkmenistan is gradually turning for Uzbekistan into a really important way for reaching the southern borders of Asia.

According to official data, in 2018, the volume of international traffic between the two countries through railways increased by 23.7 percent. Over the past 9 months of 2019, this indicator increased by another 37 percent compared to the same period last year. Positive growth is also observed in road transport. In 2018, a 3.5-fold increase was observed in this direction. Over the 9 months of last year, this indicator increased by 2.8 times compared to the same period last year. (Hasanov, 2019). Further build-up of interstate dialogue has a positive effect on trade between the two countries. If, according to statistics, in 2017, the trade between Uzbekistan and Turkmenistan amounted to $177.3 million, then the indicators for the

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next 2018 were much higher. At the end of 2018, the volume of trade between the countries increased by 70%, amounting to $302 million. Agricultural machinery, fresh and processed fruits and vegetables, mineral fertilizers, building materials, chemical and finished textile products are exported from Uzbekistan to Turkmenistan. Oil and oil products, equipment, polymers, as well as other chemical products are supplied from Turkmenistan to Uzbekistan. (TheWorldNews.net, 2019). And according to the results of the first half of 2019, the trade turnover between Uzbekistan and Turkmenistan amounted to $257 million, which is 2.8 times more compared to the same period last year (Hasanov, 2019). Large-scale implemented in Uzbekistan. The projects allowed to increase the volume of imports from Turkmenistan of various industrial goods, including cement, glass products, construction materials, equipment and furniture (Sattarov, 2017).

At the same time, the two countries did not immediately manage to settle all the problem points in bilateral relations. According to expert A. Shabalin (2018): "Visa issues remained unresolved, which is an extremely important issue for residents of the border regions, as well as the lack of air connections between the cities of the two states. Turkmenistan demonstrates readiness to be friends, but not open. And Uzbekistan's position is readiness to discuss cooperation in the field of logistics, economics and education, without touching on the "sick" topics for the neighbor. The visa regime is maintained between the two countries, in this regard, citizens of neighboring countries, primarily residents of border regions, experience difficulties crossing the border. Air traffic between Ashgabat and Tashkent was interrupted in 2013 due to financial disagreements between the parties. From 2017, all high-level meetings raised the issue of restoring air and bus connections between Uzbekistan and Turkmenistan, but so far concrete steps have been taken directions are not observed in the position of the Turkmen side.

In the section on Uzbek-Tajik relations, it was said about the intensification of communication between citizens of the two countries, the same can be said about Uzbek-Kyrgyz relations. Perhaps, if we take into account the official policy of Turkmenistan, aimed at isolation, then we should not expect rapid progress. The needs of the economy are pushing the country for openness, close ties with neighbors, including Uzbekistan. "Through the roads and railways of the two countries, trade cargo is transported, which is also sent in transit to third countries. In particular, in 2018, the volume of international traffic through railways increased by 23.7 percent. Over the past 9 months of 2019, this figure has increased by 37 percent compared to the same period last year, there is also a positive increase in road transportation. In 2018, growth in this direction was 3.5 times. Over the past 9 months of 2019, this indicator increased by 2.8 times compared to the same period last year" (Hasanov, 2019). But so far, these positive developments are not projected onto the social sphere. Having the necessary infrastructure for civil transportation, the peoples of the two countries are not free to visit each other.

3.4. Uzbekistan-Kyrgyzstan relations: analysis of trade and economic cooperation

Compared to other countries in the region, relations between Uzbekistan and Kyrgyzstan were hardened by the historical heritage of the past. The enclaves inherited by these countries as a result of an ill-conceived definition of borders by the Soviets and the water issue were the reason for the alienation between Uzbekistan and Kyrgyzstan for many years. In January 2013, Bishkek and Tashkent finally quarreled after the incident around the Uzbek enclave of Sokh, located in Kyrgyzstan. Clashes between residents of the Uzbek Sokh enclave and Kyrgyz border guards occurred due to the installation of power lines in the disputed territory. The conflict led to the isolation of Sokh with the outside world. Kyrgyz border guards completely blocked the enclave – and food stopped coming to the village of Khushyar. The countries, after an exchange of sharp diplomatic notes, ceased relations at all levels. The water issue and use of water resources were a stumbling block between the countries. Kyrgyzstan, like Tajikistan, located in the upper reaches of the Amu Darya River, has a certain advantage in terms of applying "water diplomacy" to its neighbors. Official Tashkent under the Karimov administration took a tough stance on the construction of the Kambarata-1 hydroelectric power station by Kyrgyzstan. Uzbek authorities feared that Kyrgyzstan would begin to regulate water supply in the summer.

Another important problem that has not been resolved between Uzbekistan and Kyrgyzstan for many years is the state border. The reports of conflicts, including the use of firearms, now and then came from border areas. As a result of the estrangement of the two neighboring states, it turned out, as Kyrgyz expert Igor Shestokov notes: "Paradoxically, Kyrgyzstan's relations with Russia in the economic plan and with China were better built than with Uzbekistan" (Kari, 2017). As is the case with other states in the region, the situation has changed dramatically with the change of leadership in Uzbekistan. In fact, with the advent of Mirziyoyev, the intergovernmental commission between Kyrgyzstan and Uzbekistan immediately started working, which has been in sleep mode for 8 years.

On September 5, 2017, Sh. Mirziyoyev visited Kyrgyzstan. The parties signed the "Agreement on the Uzbek-Kyrgyz state border" which clearly described 85% of its length. This, of course, was a sharp leap in bilateral relations. The most tangible sign of better relations was the resumption of the extended Dostuk/Dustlik border crossing on September 6, 2017. Thousands of citizens of both countries gathered to celebrate this event (Centre-1, 2017). Another important signal for establishing good neighborly relations between the states was that Shavkat Mirziyoyev, during a state visit to the Kyrgyzstan Republic, said that Uzbekistan was not against the construction of Kambarata-1 hydroelectric power station and agreed to participate in the implementation of this project (Tolkanov, 2019). In 2017, two energy companies of Uzbekistan and Kyrgyzstan signed a memorandum of cooperation on the Kambarata hydroelectric station. The aggravated Ungirtau problem on the border between the two countries in 2016, against the backdrop of such changes, declined and soon subsided. Sooronbay Jeenbekov paid his first official foreign visit as the President of Kyrgyzstan to Tashkent on December 13, 2017. During the two-day visit of Jeenbekov to Tashkent, agreements for $139 million were signed. An agreement was reached on providing a loan of $100 million to Kyrgyzstan.

In the spring of 2018, after a long break, railway and bus services resumed between Bishkek and Tashkent, and flights between the two capitals began to operate more often. The positive effect of the warming of relations between the countries became noticeable in the field of trade at the end of 2016. If in 2016 the volume of exports of goods from Uzbekistan to Kyrgyzstan amounted to only 67 million dollars, then in 2017 this amount amounted to 163 million dollars. In 2018, Uzbekistan sent goods for $248 million, thus, the export of goods from Uzbekistan to Kyrgyzstan increased five-fold in terms of 2016-2018. In 2018, trade between Uzbekistan and Kyrgyzstan increased by 189.6 percent, amounting to $481 million. Construction materials, agricultural and dairy products and electricity are traditionally supplied from Kyrgyzstan to Uzbekistan. Vegetables, textiles, plastic products, and automobiles are imported from Uzbekistan to Kyrgyzstan. Kyrgyz economists note the presence of an obvious negative balance in trade between the two countries and express dissatisfaction with the trade policies of the neighboring state (Figures 6-7) (Nurmatov, 2019).

Figure 6. Indexes of trade between Uzbekistan and Kirgizstan for 2016-2018

Source: Nurmatov, 2019

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Figure 7. Indexes of trade between Uzbekistan and Kirgizstan for 2016-2018

Source: Nurmatov, 2019

According to the State Statistics Committee of the Republic of Uzbekistan, the foreign trade turnover between Kyrgyzstan and Uzbekistan in 2019 amounted to 829.1 thousand US dollars, which is almost twice as much compared to the previous year. Exports amounted to 679 thousand dollars, imports – 150 thousand dollars, the share of the Kyrgyz Republic in the foreign trade turnover of the Republic of Uzbekistan amounted to 2% (Kabar, 2020).

The transport and logistics sector acts as a driver in relations between Uzbekistan and Kyrgyzstan. In October 2017, countries completed the project by opening a new route for delivering goods to China, the Tashkent-Osh-Kashgar transport corridor (route length is 900 km). The most important transport project to date, contributing to the establishment of relations between the two states, is the construction of the China-Kyrgyzstan-Uzbekistan railway, the construction of which has been talked about since 2002. This project was supported by China as part of the "One Belt – One Way" program. For a long time, there was no agreement between Kyrgyzstan and China on the technical characteristics of the future railway. "Despite the fact that Kyrgyzstan has been striving to implement this project for many years, because of the hidden opposition from Russia, the construction of the road has been delayed for all 15 years. Russia considers this region as the territory of its geopolitical interests, and therefore hindered the implementation of large projects of other powers", says the Kyrgyz analyst Aidanbek Akmat Uulu on why the implementation of this project is being delayed (Zholdoshev, 2019).

It is noteworthy that after Russia announced its participation in the project in 2018, the Chinese side made concessions in determining the technical characteristics railway, accepting the arguments of the Kyrgyz side. In this vein, it is believed that the geopolitical halo around this project will probably accelerate its implementation and thereby Kyrgyzstan and Uzbekistan will receive a strong connecting link in their relations. The Uzbek side has already alerted its section and expressed a desire to continue the construction of the road to Afghanistan and Iran (China-Kyrgyzstan-Uzbekistan-Afghanistan-Iran marching route). One of the outstanding issues is that residents of the border regions of Uzbekistan and Kyrgyzstan can cross the border without a visa only for a short time, the visa regime between the two countries has not been completely canceled. This, accordingly, prevents full-blooded relationships. A positive effect from the development of relations can be expected only if the visa regime is completely abolished (Kari, 2017).

4. **Conclusions**

The economic and political transformations in Uzbekistan initiated by the President of the Republic of Uzbekistan, Sh. Mirziyoyev, have an effect not only at the national level, but also at the regional level. An analysis of events in the region indicates an improvement in interstate relations, the establishment of a political dialogue between leaders and mutual understanding between societies. The initiative of the President of Uzbekistan was understood

and supported by the leaders of all countries. Following the Republic of Uzbekistan, the CAR states reoriented their international politics to a regional format. It has become a tradition that newly elected Presidents pay their first visit to neighboring states in the region. A step has been taken towards independence in regional processes: the leaders of the CAR countries began to gather without the participation of external factors.

The desire to resolve controversial issues and specific actions to overcome alienation between countries undertaken by Uzbekistan, supported by four states, had a positive effect on the condition of trade and economic relations between them. Already in 2017, growth was observed in trade between countries and this trend continues to this day. It is trade that is both a trigger and a driver of cooperation in the region. The analysis shows that trade is growing dynamically between Uzbekistan and Kazakhstan, between Uzbekistan and Tajikistan. Trade relations between Uzbekistan and Kyrgyzstan have a positive trend, but they have the largest negative balance. In general, if we recall times when borders in the Central Asian Region were mined, people died in border conflicts and state leaders did not communicate for years, then the current condition of interstate relations is more than encouraging. A feature of the growing relations between states in the Central Asian Region is a special emphasis on cross-border and inter-regional cooperation. Economic and trade units of regions and regions of all countries without exception support and develop interaction among themselves.

Another driver and a guarantee of stability of relations, at least in the medium term, is the fact that almost all five countries of the region are interested in developing and diversifying transport and logistics routes. All countries have their own implementing and planned projects to increase the transportation of their raw materials and goods to already established points or would like to reach new frontiers in the south and east. In such circumstances, getting around the neighbor will be at least economically disadvantageous. The global market environment itself is pushing the CAR countries to enter into close economic ties with neighboring states. Uzbekistan remains the flagship of regional cooperation as long as its political leadership understands and recognizes the economic feasibility of friendly, close ties with neighbors in the Central Asian Region. It is also true that the expanding needs of Uzbekistan's growing economy for energy and new markets will push the country towards more liberal, trusting relations with Central Asian states. Therefore, we can assume that the current problems with unresolved visa issues, gray trade, insufficient communication between the countries will be resolved in the near future.

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ECONOMIC SECURITY MANAGEMENT AT THE MESO-LEVEL: METHODOLOGICAL AND LEGAL APPROACH

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Abstract

In current conditions, one of the main tasks of state and regional government bodies is to ensure economic security at the meso-level. The solution to this problem requires, on the one hand, the development of a methodological approach for the management bodies to conduct an express assessment of economic security in the region, and on the other hand, the development of directions for legal regulation of economic security at the regional level, with the aim of increasing the level of economic security of depressed regions. The purpose of the article is to substantiate a methodological approach for conducting an express assessment of the economic security of regions as a basis for making managerial decisions in this sphere, and to substantiate the directions of legal regulation of economic security at the meso-level. The paper proposes the key indicators for the express assessment of economic security at the regional level. The authors have analyzed methodological approaches, which are available in economic science and practice, to the analysis of the level of economic security of the country and regions. The expediency of using cluster analysis for express assessment of regional economic security has been substantiated. The effectiveness of this approach has been tested on the example of the regions in Ukraine. A cluster analysis was performed for each individual indicator of economic security, as well as for all the five indicators. Leaders and outsiders in terms of economic security were identified. It has been proven that the economic security of the regions is determined by the results of their activities, the creation of the foundations by the governing bodies for the development of production and investment, employment and income of the population. The article has proposed directions of legal regulation of economic security in Ukraine, aimed at leveling threats to economic security and creating a favorable institutional and economic environment in the depressed regions of Ukraine.

Keywords: cluster, economic security, legal regulation, management, region
JEL classification: C1, K0, H70, R13, R50

1. Introduction

The economic security of a region, on the one hand, is an important component of national economic security and, on the other hand, an object of management by central and regional authorities. The socio-economic development of a regional economic system determines the

economic and financial independence of the regions, their ability to withstand internal and external threats, the capability to maintain economic stability, rational use of available resources, quantitative and qualitative development of productive forces and production relations, and, therefore, it creates the basis for both the economic security of the regions and the economic security of the national economy on the whole.

At the same time, the importance of maintaining and improving a certain level of economic security necessitates choosing a system of tools and methods for managing the economic security of the region, which would determine the economic entities' choice of the most effective of the available alternatives and the way to resist internal and external threats. It is a matter of choosing such management tools that would ensure the harmonization of economic interests at the micro-, meso- and macroeconomic levels, solve the problem of limitless needs and limited economic resources, form institutional constraints and, at the same time, opportunities for economic actors, meet both the principles of economic freedom and the norms and rules of economic behavior. Thus, the economic security of the regions is the object of management by regional and central government bodies.

Assessing the level of economic security of regions is an important and relevant scientific task, whose solution allows for effective management of economic security of regions in the short and long term, during periods of economic crisis and depression and under increasing internal and external threats and risks. On the other hand, this makes it necessary for the governing bodies to provide effective legal regulation of economic security at the regional level. It is about creating an appropriate institutional environment that would be aimed at supporting the socio-economic development of the leading regions, the formation of a favorable investment climate, and reducing internal and external risks in the depressed regions.

1.1. Literature review

In the scientific literature, the issue of methodological approaches to assessing the level of economic security at the macroeconomic level has been given considerable attention. However, the methodological principles of assessing and analyzing the economic security of regions require further development. In European countries, the United States, China and other countries, more attention is paid to assessing the security of the country in general and economic security in particular, rather than the economic security of regions, since the need to address the problem of economic growth and sustainable economic development is in focus [Losman 2001; Assemblee Nationale France 2004; Economic and Commercial Counselor's Office China 2008; Yong 2008; Luciani 1988; Cable 1995; Kirshner 1988; Belyakova et al. 2018; Koudoumakis et al. 2019]. To assess the level of economic security of regions, they use the same methodological approaches and indicators as for national economic security, since the problems of economic security of regions are not decisive for these countries. In particular, the following main approaches to the analysis of economic security used in European countries can be distinguished:

1) Nordstat's methodological approach is based on the identification and analysis of three classes of indicators: class A, which is based on indicators that can be used for interstate rankings (population size, number of objects of unfinished and completed construction, number of places in educational and medical institutions, hospitals, etc.); class B: indicators that require preliminary transformations for ranking and further adjustments in order to prevent inadequate rankings (unemployment rate, environmental quality); class C: indicators that cannot be ranked (level of social benefits, income, poverty, etc.) (Nordstat 2020);

2) the methodological approach of the DTLR (Department for Transport, Local Government and the Regions, the United Kingdom, which was renamed the Department of Transport in 2002), based on monitoring indicators of the current state of the public service delivery system, targets, survey results of households' satisfaction with the quality of services and activities of local governments [Department for Transport, the United Kingdom 1998–2002]. Similar monitoring systems are also used in Sweden (LWMS - Local Welfare Management Systems), Finland (VERTI) and other developed countries;

3) methodological approach BERI (Business Environment Risk Intelligence), based on the calculation of the risk index, which is formed on the basis of analysis of 15 quantitative

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indicators of the economic and political environment in an area and which determines the level of its economic security (BERI 2020);

4) methodological approach of the "Universe" company, based on an integral assessment of risk factors in the socio-political, domestic and foreign economic spheres. The conclusion on the level of economic security is made on the basis of expert and empirical assessment of these factors;

5) methodological approach of Euromoney magazine, which is based on the calculation of the integral index of the country's reliability as the sum of expert assessments of the level of economic efficiency, political risk, comprehensive debt, default, creditworthiness, availability of bank credit, short-term financing, long-term loan capital, and the probability of force majeure [Euromoney 2020; Zarova 2013; Hevesi 2003].

These methodological approaches have the following weaknesses: 1) they are based on the use of expert assessment methods, whose scores may be subjective, require additional verification, have certain limitations under conditions of unsustainable development and uncertainty of the environment; 2) they require the generation of a large array of input data, which is often a problem due to the delay in the publication of statistical information by national statistical services, which in turn impedes a prompt response from governmental bodies to challenges and threats to economic security.

A significant array of methods for assessing the economic security of regions has been proposed by present-day researchers in Ukraine and Russia [Senchagov and Ivanov 2015; Akberdina, Grebenkin et al. 2017; Rudenko 2017; Chichkanov, Belyaevskaya-Plotnik et al. 2020; Arkhipova, Kulikov 2020; Kharazishvili, Sukhorukov et al 2013]. In particular, the researchers proposed to assess the threats to the development of networked coupled industries, which together form an idea of the economic security of regions. The analysis was conducted by the indicators of each individual sphere in the region, in particular, indicators of industrial, food, energy, financial, personnel security, innovation and investment, social development, and environmental condition of the regions. The proposed methods allow identifying changes and diagnosing the presence of internal and external threats to the economic security of regions in the long run, but do not allow for express analysis and prompt solution to these problems in the short run.

Also, the researchers proposed a dynamic approach to the analysis of economic security of regions as a system that develops in space and time; the approach is implemented on the basis of comparative analysis, grouping and generalization of changes in capital investment per capita, the degree of depreciation, level of technological innovation, and human development index [Gagarina et al. 2019]. This allowed the researchers to conclude that the greatest threats to the economic security and sustainable functioning of regions arise in bifurcation points, which are characterized by instability, chaos, disorder; the findings reveal the need for the state support to the regions in these periods so that they were able to enter the path of sustainable development.

Also, the scientists who study the issues of economic security of regions, have formed a system of historical, cultural, economic, social indicators, which affect the socio-economic development of a region and reflect the factors of its economic security [Chichkanov et al. 2020].

Based on correlation and regression analysis, the researchers have concluded that the level of economic security, socio-economic status and development of the country and regions directly depend on the level of innovative development and implementation of digital technologies. This became the basis for the recommendations in the sphere of economic security management strategy based on digitalization in the context of global digitalization [Zarubei 2020].

The generalized results of the analysis of the existing methodological approaches to the assessment of economic security of regions led to a conclusion that they apply two major approaches, a factor and result approach. The factor approach is based on the use of assessment indicators, which are factors and at the same time threats to the economic security of the regions. They are, in particular, the amount of fixed capital, the availability of natural resources, the volume of foreign investment, the level of education and skills in the population, the state of the institutional environment, geographical location, etc.) [Samoilova 2013; Purnastuti et al. 2016; Chistnikova 2017; Batabyal 2018; Amri 2018; Myzrova 2020].

The methodological feature of this approach is the use of a large array of indicators, numbering dozens of metrics, which are the basis for the calculation of an integral index, which more fully reflects the level of economic security in the region in the opinion of its supporters.

The basis of the result approach is the assessment of economic security of regions on the basis of indicators that reveal the level of economic security achieved in the region as a result of socio-economic activities of the region. These are, in particular, indicators of the economic stability, regional income, employment and quality of life, resilience to the effects of crises, internal and external threats, etc. (Sukhorukov, Kharazishvili 2013; Pourmohammadi et al. 2014; Duran H. 2015; Correia 2017; Jayanti et al. 2019).

Despite the growing popularity of the factor approach, it has a number of significant disadvantages. In particular, the definition of an integral index is problematic, because, as a rule, the indicators used for its calculation are mainly inhomogeneous and incomparable. In addition, a large number of indicators make it difficult to make decisions and conclusions about the economic security of the regions. Furthermore, these indicators to a greater extent characterize the potential opportunities for the formation of economic security in the region and the resources and conditions that can provide it, but they do not give an idea of the security itself.

On the other hand, the result approach has significant prospects in the express assessment of the economic security condition and the formation of managerial decisions in the short term, as it involves assessing economic security based on key indicators, i.e. the results of socio-economic activities in the region, rather than a set of factors that affect it.

This approach opens up opportunities for prompt response from state and regional authorities to the problems of economic security and internal and external threats to it; it forms a methodological basis for the development of effective and efficient measures in the sphere of its regulation. This is the approach we consider the most promising for prompt assessment of economic security at the meso-level. Moreover, it will provide for a more accurate idea not only of the socio-economic results achieved in every individual region, but also of the directions of legal regulation of economic security in each of them.

In this case, the most promising methodological approach that allows such a rapid analysis, in our opinion, is the method of cluster analysis. This method is used by scientists to analyze the economic and institutional conditions in the national economy that overcome its internal and external threats (Smiesova et al. 2019), as well as to assess the possibilities of forming joint cluster groups at the enterprise and regional levels (Ivanova et al. 2020; Chairat et al. 2015 end 2020; Larionova 2018; Napolskikh et al. 2019).

1.2. Purpose

The purpose of the article is to substantiate the methodological approach for express assessment of economic security of regions as a basis for managerial decisions, as well as directions of legal regulation of economic security at the meso-level.

2. Methods

2.1. Selection of indicators

To form a methodological approach to assessing the economic security of regions, it is first necessary to justify the selection of indicators to be taken for the analysis. The major indicators for the short-term economic security assessment are presented in Table 1. In the context of the European Union's experience in assessing the level of economic security and the findings of researchers in regional economy, we propose to use GRP per capita (Gross regional product per capita) as the main indicator (P1), calculated according to the methodology of the National Accounting System [Samoilova 2013]. In the context of economic security of regions, this indicator reflects the end result of the activities and development of regions in the relevant period with reference to population, and, consequently, shows their contribution to the national economy, characterizes the level of production and distribution, final costs and consumption, the level of income and savings that have been created in the region and calculated per capita.

Employment level in the region was chosen as the P2 indicator, which characterizes the level of production development achieved in the region, the region's capability to create jobs for the able-bodied population, generate income and maintain an appropriate level of social reproduction and reproduction of the labor force. The high level of employment is the basis for the economic security of the region and reflects the level and tightness of the relationships between production and consumption in the region.

The third indicator P3 is disposable personal income per capita (Gross disposable income per head); it characterizes the level of income that can be used by the population of the region for consumption and savings, and, consequently, the level of material security, purchasing power of its population and the level of prosperity of the region as a capability to counter internal and external threats to the economy, regional differentiation of incomes, impoverishment and social tensions.

Indicator P4 is the volume of sold industrial products (goods and services) per person (Value of sold industrial production per capita); it is a characteristic of the industrial orientation of the region and at the same time the result of its production potential, stability and expansion of sales in industry, industrial development and competitiveness of industrial products, the degree of satisfaction of society's demand for industrial goods and services. These aspects are indicators of economic security (insecurity) of the region and its population, and of the effectiveness of managerial decisions in the industrial sphere.

The indicator P5 is the volume of capital investment per capita; it shows the region's capability to accumulate, attract and sell financial resources, obtain economic and social effect on the basis of investment, it characterizes the result of quantitative and qualitative renewal of production, reconstruction and modernization, and the level of innovation and investment in social facilities that meet the need of the region's population for social benefits. This indicator reflects the investment security of the region, i.e. the ability of the region to ensure expanded reproduction, technical and technological renewal, its socio-economic development, prompt response to internal and external threats, and the formation of a favorable investment climate.

2.2. Justification of the method

To assess the short-term economic security of the regions, we propose to use the method of cluster analysis based on the McKean k-means algorithm, which involves the partition of a data set into a certain number of clusters (k) by finding the cluster centroids. Vectors are divided into clusters based on the principle of minimizing the standard deviation of points in each of them and finding the smallest Euclidean distance between the object and the center.

The choice of this method is justified by its advantages. First, based on the use of this method, it is possible to establish the significance of each individual indicator in each individual period under study. Second, it is possible to avoid the inclusion of the same element (region) in several clusters and to distribute the data between non-intersecting regions. Third, it is possible to specify the number of clusters and accordingly obtain more adequate results, avoid deviations from these results and interpret them more accurately [Smiesova et al. 2019; Ivanova et al. 2020].

Weaknesses of the cluster analysis method are that: if the initial number of cluster groups is chosen incorrectly, there may be a local minimum and suboptimal distribution of data, which, in turn, can lead to incorrect results; the algorithm of the method is sensitive to data outliers and noise; the choice of different starting centers leads to different decisions. The latter aspect is due to the fact that the software package independently selects the source centers, and this determines the distribution of input data in cluster groups other than the groups selected by the researcher. Therefore, there is a need for further regrouping and adjustment of groups obtained during clustering and their additional verification by the researcher.

That is why, using this method, it is necessary to take into account the above aspects and level them.

The main stages of assessing the short-term economic security of regions on the basis of cluster analysis are presented in Table 1.

Table 1 Main indicators and stages of express assessment of economic security of regions in the short term

	Indicator	Stages of assessing economic security in the short term	
P1	GRP per capita (Gross regional product per capita) – methodology by Systems of National Accounts (SNA)	**Stage 1**	Formation of a sample of statistical data for the assessment
P2	Employment level in the region - methodology by SNA	**Stage 2**	Clustering of regions by the level of each individual socio-economic indicator (P1, P2, P3, P 4, P5)
P3	GDI per head (Gross disposable income per head) – methodology by SNA	**Stage 3**	Clustering of regions by the level of the whole set of socio-economic indicators (P1, P2, P3, P 4, P5)
P4	Value of sold industrial production per capita - methodology by SNA	**Stage 4**	Assessing the level of economic security of regions in the short term, determining the state of socio-economic development of the region, its strengths and weaknesses
P5	Capital Investment per capita – methodology of national accounting		

Developed by the authors

The clustering used K-means Clustering (k-means method), the purpose of which is the partition of *a*-observations (from the space Rb) into *k* clusters, where each observation is assigned to the cluster to whose centre (centroid) it is closest. The Euclidean distance (1) is used as a measure of approximation:

$$p(m, n) = \|m - n\| = \sqrt{\sum_{p=1}^{b} (m_p - n_p)^2}$$

(1)

where *m, n* are *Rb*

When considering the observations (m (1), m (2),… m (a)), m (j) is Rb, the method of k-means will partition *a* observations into *k* groups (or clusters) (k ≤ a), S = {S1, S2,…, Sk} so as to minimize the total quadratic deviation of the points of the clusters from the centroids of these clusters (2).

$$\min \left[\sum_{i=1}^{k} \sum_{m^{(j)} \in S_i} \left\| m^{(j)} - \mu_i \right\|^2 \right]$$

(2)

where m(j) is Rb, μi is Rb
μi is centroid of the Si cluster.

3.   Results

The formation of the sample of statistical data (stage 1) was carried out based on our selected indicators from Table 1.

Consider the methodology of express assessment of the economic security of regions and the effectiveness of managerial decisions in this sphere in the short term on the example of the regions in Ukraine for six main periods (2009, 2011, 2013, 2015, 2017 and 2018).

The sample ends in 2018, as there are no statistics for later periods. The main sources of statistical data were statistical reports and data from statistical yearbooks of the State Statistics Service of Ukraine. The calculations were performed on the basis of the cluster analysis method using the Statistica 12 software package in the Data Maining module.

For the convenience of information processing, each region was assigned a number: Vinnytsia Region – R1; Volyn Region – R2; Dnipropetrovsk Region – R3; Donetsk Region – R4; Zhytomyr Region – R5; Zakarpatska Region – R6; Zaporizhzhia Region – R7; Ivano–Frankivsk Region – R8; Kyiv Region – R9; Kirovograd Region – R10; Luhansk Region – R11; Lviv Region – R12; Mykolaiv Region – R13; Odessa Region – R14; Poltava Region – R15; Rivne Region – R16; Sumy Region – R17; Ternopil Region – R18; Kharkiv Region –

R19; Kherson Region – R20; Khmelnytsky Region – R21; Cherkasy Region – R22; Chernivtsi Region – R23; Chernihiv Region – R24.

Given the weaknesses of the cluster approach pointed out above in the substantiation of the method, we selected 4 groups of clusters, due to preliminary empirical analysis of the data, economic content of the results to be interpreted, the results of testing and adjustment by the researchers, taking into account the sensitivity of the method to data outliers and noise.

Thus, using the cluster approach, we obtained four groups of regions according to the level of their economic security: Cluster 1 – regions with a low level of economic security, Cluster 2 – regions with a medium level of economic security; Cluster 3 – regions with the economic security level above average; Cluster 4 – regions with a high level of economic security. At stage 2, the dynamics of socio–economic indicators in the regions (P1, P2, P3, P4, and P5) was analyzed and the regions were clustered according to the level of each of these indicators.

Table 2 shows the results of clustering of the regions according to the level of GRP per capita (P1).

Table 2 Clustering of the regions by the level of P1 (GRP per capita), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	12145	1	17768	1	22303	1	37270	2	58384	3	71104.0	2
R2	11796	1	16993	1	19817	1	30387	2	49987	2	58297.0	2
R3	27737	4	42068	4	46333	4	65897	4	97137	4	114784.0	4
R4	23137	3	36446	3	37830	3	*	-	*	-	*	-
R5	11419	1	17184	1	20286	1	30698	2	49737	2	62911.0	2
R6	10081	1	14455	1	17044	1	22989	1	34202	1	41706.0	1
R7	20614	3	27567	2	30526	2	50609	3	75306	3	85784.0	3
R8	12485	1	19386	1	24022	2	33170	2	46312	2	57033.0	2
R9	21769	3	34420	3	39988	3	60109	4	90027	4	112521.0	4
R10	13096	1	19918	1	25533	2	39356	2	55183	2	67763.0	2
R11	16562	2	25067	2	24514	2	-	-	-	-	-	-
R12	14093	2	20490	1	24937	2	37338	2	58221	3	70173.0	2
R13	17050	2	23402	2	27355	2	41501	3	60549	3	70336.0	2
R14	20341	3	25748	2	29118	2	41682	3	62701	3	72738.0	2
R15	22337	3	35246	3	39962	3	66390	4	106248	4	123763.0	4
R16	11699	1	16735	1	19003	1	30350	2	42038	2	49044.0	1
R17	13631	2	19800	1	23517	2	37170	2	51419	2	62955.0	2
R18	10240	1	15055	1	16819	1	24963	1	38593	2	46833.0	1
R19	21228	3	27966	2	31128	2	45816	3	69489	3	86904.0	3
R20	12256	1	16990	1	19311	1	30246	2	45532	2	52922.0	1
R21	11780	1	17260	1	20165	1	31660	2	49916	2	59583.0	2
R22	14393	2	21082	1	26168	2	40759	3	59697	3	76904.0	3
R23	9383	1	13228	1	15154	1	20338	1	31509	1	37441.0	1
R24	13121	1	19357	1	22603	1	35196	2	55198	2	69725.0	2

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

Table 2 shows that in the study period there is a significant gap between the regions by P1, and accordingly in 2009 the first group (with a low rank by P1) included 14 regions: R1, R2,

R5, R6, R8, R10, R16, R18, R20, R21, R23, R24; only one region could be assigned to the group of leaders – R3. By the end of 2018, there are already three leading regions with the highest P1: R3, R9, R15, as well as five regions with the lowest level of P1 (R6, R16, R18, R20, R23). The other regions are in the group with an average level of P1 – R1, R2, R5, R8, R10, R12, R13, R14, R17, R21, R24, and a level above the average – R7, R19, R22.

It should also be noted that in dynamics, the regions R1 and R22 have significantly improved their ranking, while the situation in the regions R4 and R11, on the contrary, has deteriorated significantly, which is explained by the military actions that are being carried out in these areas, and by socio–economic and political crisis, which negatively affect their economic condition.

The results of clustering of the regions by the coefficient P2 (Employment level in the region) are presented in Table 3.

Table 3 Clustering of the regions by the coefficient P2 (Employment level in the region)

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	0.89	1	0.90	1	0.92	2	0.91	3	0.89	3	0.71	3
R2	0.91	3	0.92	3	0.92	2	0.90	2	0.88	1	0.60	1
R3	0.92	4	0.93	4	0.93	4	0.93	4	0.92	4	0.73	4
R4	0.91	3	0.92	3	0.92	2	0.86	-	0.85	-	*	-
R5	0.89	1	0.90	1	0.91	1	0.89	1	0.89	2	0.71	3
R6	0.90	2	0.90	1	0.92	2	0.91	3	0.90	3	0.65	2
R7	0.92	4	0.93	4	0.93	4	0.90	2	0.89	3	0.72	4
R8	0.91	3	0.91	2	0.93	3	0.92	3	0.92	4	0.67	2
R9	0.92	4	0.93	4	0.94	4	0.94	4	0.93	4	0.71	3
R10	0.90	2	0.91	2	0.92	2	0.89	1	0.88	1	0.68	3
R11	0.92	4	0.93	4	0.94	4	0.84	-	0.83	-	*	*
R12	0.92	4	0.92	3	0.93	3	0.92	3	0.92	4	0.69	3
R13	0.91	3	0.92	3	0.93	3	0.91	3	0.90	3	0.73	4
R14	0.93	4	0.94	4	0.95	4	0.94	4	0.93	4	0.70	3
R15	0.90	2	0.91	2	0.92	2	0.88	1	0.88	1	0.69	3
R16	0.87	1	0.90	1	0.91	1	0.90	2	0.88	2	0.68	3
R17	0.89	1	0.91	2	0.92	3	0.90	2	0.91	4	0.74	4
R18	0.89	1	0.90	1	0.91	1	0.88	1	0.88	1	0.64	1
R19	0.92	4	0.93	4	0.94	4	0.93	4	0.94	4	0.77	4
R20	0.91	3	0.91	2	0.92	2	0.90	2	0.89	2	0.72	4
R21	0.90	3	0.91	2	0.92	2	0.90	2	0.91	4	0.70	3
R22	0.89	1	0.91	2	0.91	1	0.90	2	0.90	3	0.73	4
R23	0.91	3	0.92	3	0.93	3	0.91	3	0.92	4	0.69	3
R24	0.89	1	0.90	1	0.91	1	0.89	2	0.89	2	0.74	4

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

According to the results, eight regions are top-ranking by the indicator P2: R3, R7, R13, R17, R19, R20, R22, R24, while R2 and R18 are among the outsiders. On the whole, the employment rate increased significantly in 2018 compared to 2009.

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The obtained data clearly reflect the trend to a decrease in the economically active population, its aging and depopulation occurring in Ukraine over the past 24 years. Negative reproduction of the economically active population worsens the situation concerning the use of the country's labor potential.

Table 4 shows the results of clustering according to the GDI per head indicator (Gross disposable income per head): the regions R3 and R7 are steadily in the cluster group showing the highest rates; the regions R9, R14, R15, and R19 belong to the regions with the P3 level above the average.

Table 4 Clustering of the regions by the level of P3 (GDI per head), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	12380	2	18680	2	22715	2	28627	2	43725	3	54992	2
R2	11131	1	16391	1	19491	1	24474	1	38069	1	46475	1
R3	16647	4	23724	4	29940	4	38346	4	54215	4	72883	4
R4	17381	4	24623	4	29981	4	*	-	*	-	*	-
R5	12385	2	18429	2	21452	2	27030	2	41787	2	52136	2
R6	10028	1	14663	1	17898	1	21447	1	33282	1	40472	1
R7	16174	4	23143	4	28474	4	35379	4	52727	4	67982	4
R8	12015	2	17238	2	20964	2	25613	2	39326	2	48368	2
R9	15086	3	22408	3	26766	3	33072	3	50321	4	63498	3
R10	11758	2	17712	2	21377	2	26728	2	40877	2	51018	2
R11	14368	3	20589	3	25186	3	*	-	*	-	*	-
R12	13657	3	19240	2	22623	2	28796	2	44194	3	55511	2
R13	13298	2	19638	2	23689	2	28750	2	43852	3	55544	2
R14	12622	2	18878	2	25082	3	31568	3	48474	3	61166	3
R15	14747	3	20485	3	24958	3	31749	3	47075	3	60217	3
R16	11531	2	17040	1	20711	2	26042	2	38881	2	47729	1
R17	13656	3	19101	2	22994	2	29773	3	44323	3	55934	2
R18	10733	1	16011	1	18997	1	23241	1	35211	1	43513	1
R19	14902	3	21421	3	26227	3	31224	3	46790	3	60118	3
R20	11606	2	17210	2	21345	2	26458	2	40243	2	50109	2
R21	12332	2	18386	2	22433	2	28340	2	42350	2	52488	2
R22	12404	2	17798	2	21477	2	26700	2	40589	2	50293	2
R23	10275	1	15634	1	18741	1	23491	1	35403	1	42850	1
R24	12996	2	18714	2	23567	2	27672	2	41328	2	50895	2

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

During the whole period, the lowest levels of P3 have been shown by the regions R2, R6, R16, R18, R23, which are ranked as the most depressed regions.

The dynamics of this indicator reflects the real economic situation in the regions, as well as the institutional conditions in which production is carried out, science and technology develop.

Ukraine is one of the countries with high income differentiation that has significantly increased in recent years.

The obtained data show that in this country it is the natural and climatic conditions, the level of reserves of natural resources, the development of industries that determine the available income and the level of material security of the population, as well as the differentiation of regions by this indicator.

The level of per capita income is low in the regions where the spheres of production and services are underdeveloped, there is no regional infrastructure, and no favorable conditions have been provided for the creation of new jobs and employment. Those are the causes for the assignment of these regions to the cluster groups with a low level of economic security.

According to the indicator P4, which reflects the Value of sold industrial production per capita, the cluster group of top-ranking regions (Table 5) has included R3 and R15 in the recent period, while R3 has been steadily in this cluster.

Table 5 Clustering of the regions by the level of P4 (Value of sold industrial production per capita), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	8761	1	12795	1	15627	1	30446	3	45818	3	53284	2
R2	6316	1	10096	1	10474	1	18457	2	28132	2	32284	1
R3	33207	4	60236	4	66109	4	92509	4	136015	4	160411	4
R4	31544	4	60580	4	50791	3	40888	-	63475	-	*	-
R5	7841	1	11229	1	13000	1	20557	2	33415	2	41669	1
R6	4588	1	7010	1	7985	1	10977	1	17805	1	20526	1
R7	29338	3	45316	3	44200	3	76837	4	114610	4	129045	3
R8	8084	1	17438	2	15928	1	24633	2	35452	2	54721	2
R9	17703	2	26342	2	32366	2	42083	3	64368	3	81223	2
R10	7626	1	11976	1	18487	1	23616	2	30931	2	35543	1
R11	25187	3	42937	3	32443	2	10391	-	11289	*	*	-
R12	8504	1	12736	1	13640	1	22659	2	36155	2	43797	1
R13	14190	2	18565	2	19373	2	30061	3	46981	3	52944	2
R14	10989	2	11339	1	12444	1	22231	2	28315	2	30974	1
R15	26080	3	49154	3	49015	3	77258	4	136723	4	151966	4
R16	7802	1	13120	1	13552	1	23103	2	31591	2	34817	1
R17	10549	2	20335	2	21143	2	33006	3	39247	2	48619	1
R18	4738	1	7538	1	7570	1	11421	1	20607	1	23729	1
R19	16110	2	23134	2	28538	2	41240	3	68561	3	82389	2
R20	7388	1	10075	1	10146	1	16070	1	26856	2	29579	1
R21	7577	1	11368	1	13430	1	20796	2	31520	2	34120	1
R22	13873	2	22502	2	23531	2	38410	3	56282	3	65541	2
R23	3324	1	4334	1	4513	1	7493	1	12651	1	17551	1
R24	9441	1	13962	1	17527	1	26415	2	46436	3	44118	1

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

The results of clustering indicate a decrease in the number of depressed regions by the level of P4 in 2015 and 2017 and a 2018 increase in their number to fifteen, including R2, R5, R6, R10, R12, R14 R16, R17, R18, R20, R21, R23, and R24. Accordingly, the number of regions with an average level of economic security in terms of P4 has decreased.

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The obtained results indicate a significant polarization between the regions in terms of industrial potential.

The results of clustering by the indicator P5 are presented in Table 6.

In the last period, the number of low-ranking regions by the indicator P5 has significantly increased (from 3 to 16), and there is only one top-ranking region R9.

Table 6 Clustering of the regions by the level of P5 (Capital Investment per capita), monetary units

	2009	cluster	2011	cluster	2013	cluster	2015	cluster	2017	cluster	2018	cluster
R1	1636	1	3427	2	3769	2	4619	2	7425	2	11279	2
R2	2315	2	2118	1	3169	1	5946	3	6741	2	8403	1
R3	3964	4	5451	3	6469	3	7957	3	13277	4	18806	3
R4	2910	3	4906	3	6423	3	1946		4119	*	*	-
R5	1789	1	2985	2	2376	1	3206	1	6254	2	7130	1
R6	1526	1	2319	1	2148	1	3018	1	4451	1	5968	1
R7	2539	2	3349	2	3829	2	4448	2	9227	3	9204	1
R8	2463	2	2609	1	3473	2	6945	3	7042	2	6845	1
R9	5808	4	8956	4	11997	4	14086	4	19666	4	23022	4
R10	2751	3	4489	3	3240	1	4213	2	7634	2	7614	1
R11	1903	1	2684	1	5090	2	952	-	1522	-	*	-
R12	2628	2	4487	3	3861	2	5288	2	9527	3	11499	2
R13	3363	3	3480	2	4279	2	5181	2	9813	3	8929	1
R14	4182	4	3392	2	4966	2	4184	2	9358	3	9999	2
R15	5135	4	6905	4	6515	3	5768	3	11246	3	13282	2
R16	2345	2	2426	1	2416	1	3701	1	5256	1	6221	1
R17	1877	1	2430	1	2383	1	3324	1	6305	2	7120	1
R18	1286	1	2129	1	2795	1	3566	1	6842	2	8031	1
R19	2997	3	3902	2	3398	1	4120	2	7201	2	8821	1
R20	1921	1	2585	1	1958	1	2918	1	7068	2	8578	1
R21	2624	2	3030	2	2754	1	5253	2	8239	2	8935	1
R22	2316	2	2349	1	2698	1	3620	1	6637	2	9201	1
R23	2875	3	2430	1	2532	1	3077	1	3309	1	4091	1
R24	1442	1	2297	1	2718	1	3349	1	7254	2	8948	1

Source: Calculated by the authors based on the State Statistics Service of Ukraine for 2009–2018.

Note: * Data are missing due to the impossibility of taking into account the results of part of the temporarily occupied territories in Donetsk and Luhansk regions

The number of regions with average and above-average indicators of investment activity has also decreased. Declining investment activity is one of the reasons for the polarization of the regions in this country and the growth of economic threats.

Clustering by all the indicators provided for obtaining the following classification of the regions, presented in

Table 7. In 2018, compared to 2009, the number of depressed regions decreased to six (R2, R6, R8, R16, R18, R23), at the same time the number of top-ranking regions increased (R3, R7, R15).

The group of regions with average indicators includes 12 regions: R1, R5, R10, R12, R13, R14, R17, R19, R20, R21, R22, and R24. R9 has higher than average values. Luhansk and

Donetsk oblasts were not included in the regions analyzed in 2017-2018, as statistical information does not reflect the real situation in these regions.

The obtained results of the express assessment of economic security in the regions of Ukraine lead to the conclusion about the need for effective legal regulation in this sphere by state and regional authorities. The authorities should focus on the formation of a favorable institutional environment in the depressed regions, as well as on the formation of united cluster groups of regions, which will increase the level of economic security in each of the regions participating in such a cluster association. In this regard, we propose to take the following measures in the sphere of legal regulation of economic security in Ukraine.

Table 7 Clustering of the regions by the five indicators

cluster	2009	2013	2017	2018
1	R1, R5, R6, R16, R17, R18, R22, R24	R1, R2, R5, R6, R10, R16, R18, R20, R21, R22, R23, R24	R6, R8, R24	R2, R6, R8, R16, R18, R23
2	R2, R8, R10, R,12 R13, R14, R20, R21, R23	R8, R11, R12, R13, R14, R17, R19	R2, R5, R10, R16, R18, R20, R24	R1, R5, R10, R12, R13, R14, R17, R19, R20, R21, R22, R24
3	R4, R7, R11, R,19	R4, R7, R9, R15	R1, R12, R13, R14, R17, R19, R21, R22	R9
4	R3, R9, R15	R3	R3, R7, R9, R15	R3, R7, R15

Calculated by the authors

State support for the development of regions in Ukraine should include measures to form a legal and informational basis for maintaining the economic security of regions through the formation of their cluster groups, which includes the following measures:

- The Ministry of Economic Development and Trade of Ukraine should finalize and submit to the Cabinet of Ministers of Ukraine "Concept of Creating Clusters in Ukraine", and on its basis to propose a "Program for the Creation of Regional Clusters in Ukraine";

- Cabinet of Ministers of Ukraine and the State Agency for e-Government of Ukraine should stimulate the development and implementation of an official Internet agency representation, which will inform about the existing cluster groups in the regions and provide legal support to the regions that are forming the core of the cluster group at the level of central and regional government bodies;

- The Cabinet of Ministers of Ukraine, in order to study the prospects for creating cluster networks in the regions of Ukraine, should assemble an interdepartmental working group for working out a policy for the development of regional clusters in Ukraine with the involvement of leading Ukrainian and foreign experts; this will make it possible to conduct research and identify the most promising existing and potential clusters and to provide them with financial and organizational support from the state, by organizing a competition and selecting the best innovative projects for implementation;

- The National Academy of Sciences, with the support of the Ministry of Economic Development and Trade of Ukraine, should ensure the formation of a database on existing projects for the creation of regional clusters requiring investment and state support, which will result in revival in the field of the cluster formation;

- The State Agency for Electronic Government of Ukraine and the Ukrainian Chamber of Commerce and Industry should popularize the advantages of cluster interaction between the regions by conducting educational events for the regions, inform foreign partners about the prospects and benefits of cooperation with Ukrainian cluster networks, and cover the functioning of national clusters in the media.

In addition to the legal support of the development of regional clusters in Ukraine, it is advisable to introduce subject-institutional support of regional clustering processes, which provides for close cooperation with government officials (at all levels), business, professional,

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public and research organizations in order to identify, agree, advocate and coordinate of interests of the participants in the clustering process. Achieving this goal is possible under the conditions of forming an independent structural unit within the Ministry of Economic Development and Trade of Ukraine, which should concentrate the responsibility and authority for the implementation of cluster policy; monitor the use and allocation of organizational and financial resources; conduct benchmarking research; control the implementation of pilot projects for the creation of clusters; monitor, assess and promptly adjust the cluster policy.

4. **Conclusions**

The scientific approach to assessing the economic security of the regions on the basis of cluster analysis enabled conducting its express analysis on the example of the regions of Ukraine, identifying the groups of regions with relatively equal and different levels of socio-economic development, determining the place and socio-economic status of each individual region and the management weaknesses and strengths in this sphere. A significant difference in the indicators P3, P4, P5 has been found between the leaders and outsiders, which indicates differentiation in the development of these regions and determines a high (low) level of economic security both in these regions and in the country as a whole.

The proposed approach to express assessment of economic security of the regions allows quick diagnosing and forming a general idea of the socio-economic status of the regions and the effectiveness of state and regional governance. This is the basis for threat management and developing business strategies at the regional level, creating favorable conditions for production development, increasing investment activity, income and employment, eliminating differentiation between leading and outsider regions, responding promptly to internal and external changes in the environment.

The proposed measures in the field of legal regulation of economic security of regions are aimed at improving the socio-economic situation of the depressed regions of Ukraine and using the advantages of leading regions to solve the problem of differentiation of the regions by Gross regional product, income and employment per capita, industrial production and fixed capital investment. This is possible on the basis of uniting the regions into regional cluster groups, the formation of the appropriate legal and information basis by the state, as well as direct support for such an initiative by state and local governments.

Prospects for further research in this direction may be the use of fuzzy logic methods and the construction of an integral index of economic security of the region, which will be the basis for the formation of a comprehensive approach to assessing economic security at the meso level.

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FACTORS AFFECTING ON URBAN LOCATION CHOICE DECISIONS OF ENTERPRISES

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Abstract

This paper focuses on analyzing the origin data source to find out the principle motives and preferences which influence the location choice behaviors of individual firms in Tokyo metropolitan area. A modeling framework is developed to analyze decisions regarding location choice for enterprises using a multinomial logit model. In case study, the proposed model is tested for retailers, wholesalers, warehouses and manufacturers. The results indicate that for choosing a location, the number of employees is a more important determinant for manufacturers and warehouses than that for retailers and wholesalers. Additionally, the results indicate that transportation cost and the land prices in a given zone strongly affect the decision making process of all the firms in the metropolitan area.

Keywords: Multinomial Logit Model, Location Decision Behavior, Location Choice Model

1. INTRODUCTION

This study not only aim to investigate all the characteristics of enterprises, zone's attributes, interactions among enterprises and zone alternatives but also develop a model that considers the influence of observable and unobservable factors on the location choice decision of each enterprise and its interaction within dynamic business environments. The individual business location choice decision process is illustrated in the model conceptual framework. In which, a multinomial logit model have been applied to explain these processes in the business dynamic environment. In addition, the maximum likelihood estimation has been used to estimate the parameters of the proposed model.

The next section introduces the literature review of the application of a multinomial logit model. The third section describes the approach taken in this study. The fourth section presents a case study based on data from the Tokyo Metropolitan area. Discussion of the results, the conclusions and recommendations are presented in the fifth section and the sixth section, respectively.

2. LITERATURE REVIEW

Maoh and Kanaroglou (2007) present a microanalytical firm mobility model for the City of Hamilton, Canada, developed with data from the Statistics Canada Business Register. In this article evidence is provided that the willingness to move can be explained by firm's internal characteristics (e.g. age, size, growth and industry type) as well as location factors related to the urban environment where the firm is located. Numerous studies have examined the relative significance of various factors in the business location choice process by developing theoretical models to explain the different facets of the process (Ozmen-Ertekin et al. 2007). In practice, the choice of location is determined by an individual firm, which follows a complex process to evaluate the trade-offs among different locations. The choice of location is generally influenced by factors such as the characteristics of the firm, the attributes of the zones being considered, and transportation accessibility (Ozmen-Ertekin et al. 2007).

Löchl et al. (2010) apply UrbanSim software to modelling hedonic residential rents for land use and transport simulation while considering spatial effects. Spatial simultaneous autoregressive approaches proved to be a reasonable alternative in the analysis, which can be implemented in UrbanSim more easily because of its structure of a single set of resulting parameters in his research. Schirmer et al. (2014) not only considers the role of location in residential location choice models but also proposes a common classification for location

variables and categorize findings from a wide range. His results show that in addition points of interest (e.g., schools, school quality, retail, transport elements) and previous residential locations are attributes that should be included in choice models in transport land-use simulations. Nilsen et al. (2020) indicate that the decision to relocate is influenced by a firm's internal and external characteristics such as agglomeration. His results show that firms prefer areas with good access to skilled and diverse labour marked and are pulled towards larger markets often found in urban areas.

3. METHODOLOGY

This paper proposes the realistic location choice model to analyze decisions regarding location choice for enterprises using a multinomial logit model.

Table 1 Assumption and Utility Function of Proposed Models

Individual firm location choice models	Assumptions		Formula of utility function $U_{ni} = V_{ni} + \varepsilon_{ni}$	
	Deterministic Part (V_{ni})	*Error part* (ε_{ni})	*Deterministic part* (V_{ni})	*Error part* (ε_{ni})
MNL Multinomial Logit (MNL)	The responsiveness to attributes of alternatives across individuals is assumed to be homogeneous after controlling for observed individual firm characteristics	IID assumption with Gumbel distribution	V_{ni}	ε_{ni}

Table 1 firstly shows that the random components of the utilities of the zones in the multinomial logit model are assumed to be independent and identically distributed (IID) with a type I extreme value distribution (Johnson and Kotz, 1970). In addition, the responsiveness to attributes of zones across individual firms is assumed to be homogeneous after controlling for observed individual firm characteristics. On the basis of these two assumptions, this paper proposed origin location choice model of an individual firm using the multinomial logit model to develop.

Figure 1 Conceptual Framework of Location Choice Models
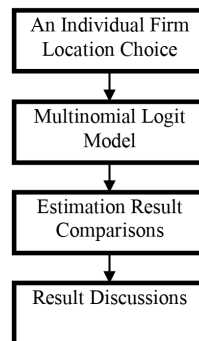
4. DATA COLLECTION FOR CASE STUDY

The attributes of each zone, the characteristics of each individual firm and spatial interactions have been collected from numerous data source. In which, the number of population of the zone was collected from the Population census of Japan. The number of employees of the zone was collected from the Establishment and Enterprise Census. Furthermore, the average land price of zones was collected from the Land Price Survey of Japan. The characteristics of each individual firm were collected from the TMGMS. The address of each individual firm is available in the TMGMS. Therefore, the distance among the firms can be calculated directly from the address of each firm. However, to make simply the computation, the distance among the firms can be calculated on the basis of the distance among C zone types (based on the three digits of city code) which each individual firm belongs to.

The percentage of firms by industry type in each zone is depicted in Figure 2. The zones in the centre of Tokyo prefecture and the nearby zones comprise many light product manufacturers, wholesalers, warehouses, retailers. The heavy product manufacturers

including chemical manufacturers, metal manufacturers, and machinery manufacturers, are located outside the centre of the city, in Tokyo, Saitama, and Kanagawa prefectures. This means that there are many industrial clusters which include heavy and light manufacturer clusters, wholesalers and retailer clusters in the zones of the south part of Saitama and Tokyo city, respectively. This implies that transportation costs resulting from the distance that links input resources, the firm's location and customers or the market can lead industries to agglomerate in certain areas to capture the positive externalities arising from economies of scale and agglomeration in these zones (Fujita and Thisse, 2002). In other words, individual firms, in aiming to minimize their observable spatial transaction costs, have implicitly or explicitly determined that this is best achieved by locating close to other firms within the particular input- output production and consumption hierarchy of which they are parts (Isard and Vietorisz,1955; McCann, 1995).

Figure 2 Percentage of Firms in each Zone for each Industry Type

I1) Chemical Manufacturers

I2) Metal Manufacturers

I3) Machinery Manufacturers

I4) Other Manufacturers

I5) Warehouse

I6) Material Wholesalers

I7) Product Wholesalers
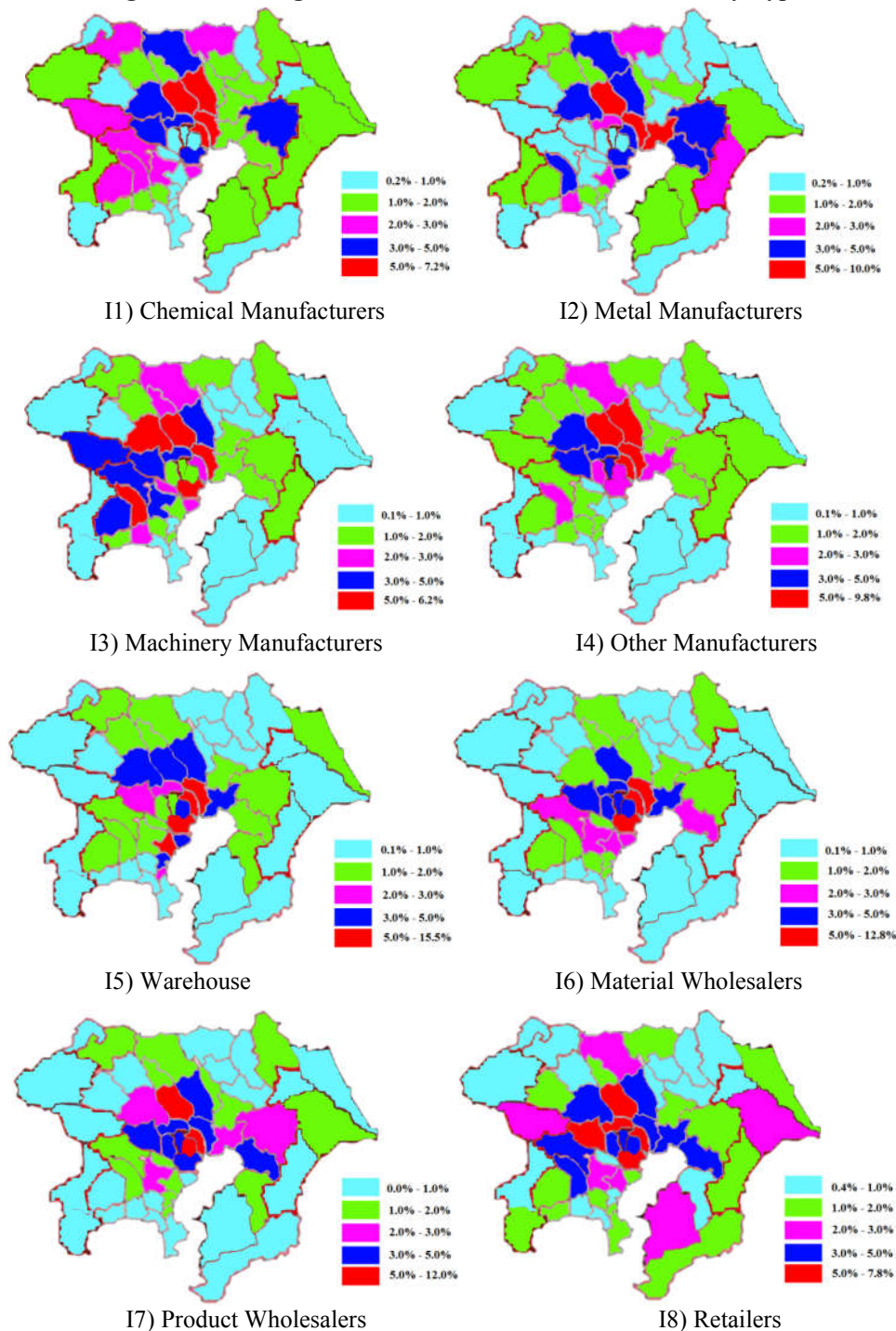
I8) Retailers

In addition, the agglomeration of manufacturers, wholesalers and retailers also increases the possibilities of specialization between firms as more specialized tasks in the firms could be outsourced. This is especially true for the workforce as it is often highly specialized, and the agglomeration of firms within the same industry creates a large labour pool of specialists in that particular industry which is an advantage for the individual member of the cluster in each zone (Madsen et al. 2003).

Figure 3 Percent of Firm in each Zone comparing with Other Industry Types

I1) Chemical Manufacturers   I2) Metal Manufacturers

I3) Machinery Manufacturers   I4) Other Manufacturers

I5) Warehouse   I6) Material Wholesalers

I7) Product Wholesalers   I8) Retailers
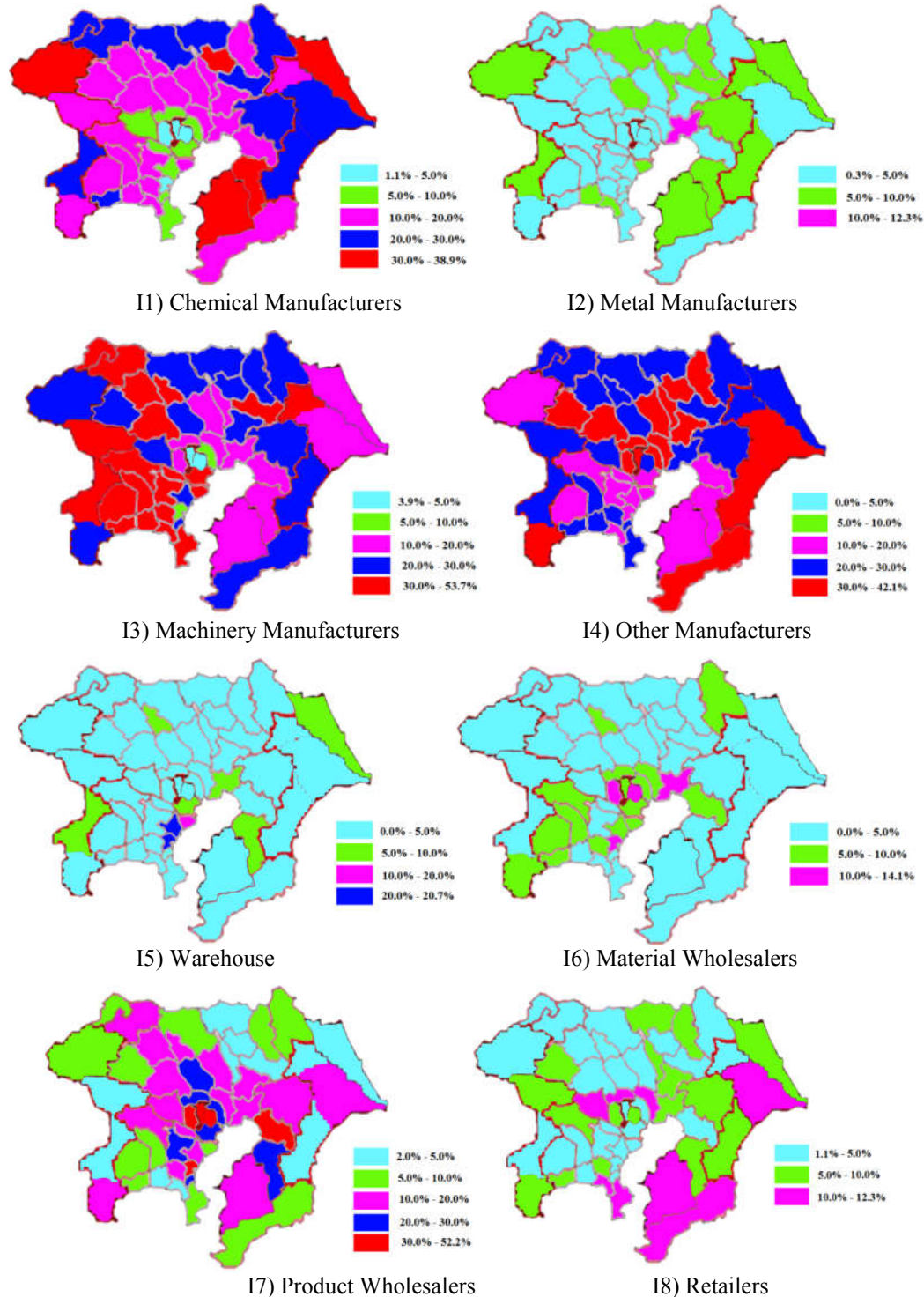
Figure 3 illustrates the proportion of each industry type comparing with the rest other industry types in each zone. Chemical manufacturers, machinery manufacturers, other manufacturers, product wholesalers and retailers keep the main proportion in each zone of Tokyo Metropolitan Area. Figure 3 indicates that manufacturers, wholesalers and retailers are located with a high percentage in contiguous zones which are neighbors. This means that the

zones which located nearby the good attractive zones will be getting more attractive to individual firms in their location choice decisions.

5. <u>RESULTS AND DISCUSSIONS</u>

Table 2 shows the estimation results of the individual firm location choice model by the multinomial logit model for chemical manufacturers, metal manufacturers, machinery manufacturers, other manufacturers, warehouses, material wholesalers, product wholesalers and retailers. The average land price and accessibility of each zone have a statistically significant and negative effect on the zone which is selected as a firm's location for all types of industry. The negative sign of the average land price of each zone means that most firms prefer to choose the zone which has a low land price to maximize their profit. In this research, the accessibility's value of each zone is directly proportional to the average distance to other zones. The value of accessibility of zone for retailers shows that retailer prefers to choose the zone which has a shorter average distance in comparison with that of manufacturers, warehouses or wholesalers. The reason can be explained since generally the density of retailers in a zone is very high and the distribution of the products among retailers is commonly in the short distance.

Table 2 indicates that population density and number of employees of each zone, these factors have a statistically significant and positive effect on that zone being selected as a firm's location for manufacturers, warehouses, wholesalers and retailers. This means that many firms are more likely to locate in zones that have a high population density and a large employee pool. It can be interpreted that the companies can reduce the cost of recruitment that is an important cost for manufacturers and warehouses. With regard to the retailers, they try to locate in the location which is close to the customers to get more benefit. It is straightforward to see that the influence of population density and number of employees of each zone on the firm location choice decision of other manufacturers is the highest. The reason for this is that other manufacturers require a larger number of employees than that of each retailer and product wholesaler.

As regards the distance from firm's location to the nearest IC highway, the parameter's value of manufacturers, warehouses, wholesalers and retailers keep an important role. This can be interpreted that many firms prefer the location which is located close to the IC highway to reduce the travel distance and these firms can reduce the transportation cost which is a very important cost for each firm. Transportation cost also keeps an important role in the firm location choice decision for firms based on the high value of t statistic. The negative sign of transportation cost indicates that a lot of firms prefer the location which has a low transportation cost to their customers, suppliers or other firms.

With regard to the number of employees and the floor area of each firm, the t-statistic' values of employee and floor are -0.71 and 0.10 for retailers, respectively. This means that the influence of the number of employees or floor area of each firm on the firm location choice decision for retailers is lower than those of manufacturers, warehouse, material and product wholesalers. It can be interpreted that manufacturers, warehouses and wholesalers require a larger floor area than that of retailers. Moreover, the negative sign of this factor means that the employee number of firms is larger, it will make more difficult for their location choice decision. In addition, the value of transportation cost is lowest for retailers. This can be explained that the weight of commodity is small for retailers and the travel distances of retailers to customers or suppliers are often short in urban areas.

Table 2 Estimation Results of Proposed Model by Multinomial Logit Model

Variables	Chemical Manufacturer Coefficients (*t-value*)	Metal Manufacturer Coefficients (*t-value*)	Machinery Manufacturer Coefficients (*t-value*)	Other Manufacturer Coefficients (*t-value*)
Zonal Attributes Variables				
Average land price of zones (1,000 yen/ m^2)	-0.0019 (-10.78)	-0.0033 (-6.69)	-0.0009 (-5.61)	-0.0037 (-17.52)
Population density of zones (in 1,000 persons/ km^2)	0.0356 (1.56)	0.1210 (4.80)	0.1501 (18.69)	0.3091 (23.56)
Accessibility of zones (1,000 m)	-0.0437 (-11.09)	-0.0039 (-0.51)	-0.0643 (-15.36)	-0.0400 (-5.68)
Number of employee of zones (in 1,000 persons)	0.0023 (12.93)	0.0033 (6.65)	0.0005 (2.35)	0.0043 (20.25)
Firm Characteristics Variables				
Distance from Firm to IC Highway (1,000 m)	-0.1909 (-3.38)	-0.1805 (-4.61)	-0.4681 (-6.91)	-0.8586 (-8.90)
Transportation Cost (100,000 yen)	-0.0835 (-5.87)	-0.0216 (-1.47)	-0.0467 (-6.91)	-0.0529 (-4.01)
Number of employee of firms (in persons)	0.0060 (8.95)	-0.0149 (-5.22)	0.0190 (4.82)	0.0208 (8.95)
Floor area of firms (m^2)	-0.4521 (-7.80)	0.0540 (7.83)	-1.5083 (-9.27)	-0.4093 (-4.05)
Number of observation	1300	200	1700	1600
Log-likelihood at convergence	-4709.3	-708.0	-5817.8	-4105.2
Log-likelihood at zero	-5136.6	-790.2	-6717.1	-6321.9
Log likelihood ratio	0.083	0.104	0.133	0.350
AIC test	7.25	7.17	6.85	5.14
Hit Ratio (%)	3.76	9.23	2.52	16.87

Variables	Warehouse Coefficients (*t-value*)	Material Wholesaler Coefficients (*t-value*)	Product Wholesalers Coefficients (*t-value*)	Retailers Coefficients (*t-value*)
Zonal Attributes Variables				
Average land price of zones (1,000 yen/ m^2)	-0.0004 (-1.31)	-0.0015 (-5.18)	-0.0009 (-4.96)	-0.0010 (-2.39)
Population density of zones (in 1,000 persons/ km^2)	0.0207 (1.41)	0.1746 (12.36)	0.0740 (7.35)	0.1371 (6.53)
Accessibility of zones (1,000 m)	-0.0122 (-2.04)	-0.0103 (-1.68)	-0.0256 (-5.14)	-0.0328 (-2.89)
Number of employee of zones (in 1,000 persons)	0.0015 (4.55)	0.0017 (5.32)	0.0022 (10.10)	0.0006 (1.57)
Firm Characteristics Variables				
Distance from Firm to IC Highway (1,000 m)	-0.0316 (-1.16)	-0.0449 (-0.92)	-0.5477 (-6.15)	-0.9978 (-8.48)
Transportation Cost (100,000 yen)	-0.0052 (-2.15)	-0.0208 (-2.73)	-0.0033 (-1.75)	-0.5099 (-3.45)
Number of employee of firms (in persons)	0.0037 (1.96)	0.0095 (4.40)	0.0046 (1.16)	-0.0051 (-0.71)
Floor area of firms (m^2)	-0.0119 (-1.30)	0.1374 (1.70)	-0.0088 (-1.06)	0.9672 (0.10)
Number of observation	400	600	1400	220
Log-likelihood at convergence	-1447.3	-1955.1	-4058.6	-719.6
Log-likelihood at zero	-1580.4	-2370.7	-5535.6	-869.2
Log likelihood ratio	0.084	0.175	0.266	0.172
AIC test	7.28	6.54	5.80	6.62
Hit Ratio (%)	14.48	4.03	10.45	10.00

Figure 4 Validation of Estimation Results by Multinomial Logit Model

I1) Chemical Manufacturers

I2) Metal Manufacturers

I3) Machinery Manufacturers

I4) Other Manufacturers

I5) Warehouse

I6) Material Wholesalers

I7) Product Wholesalers

I8) Retailers
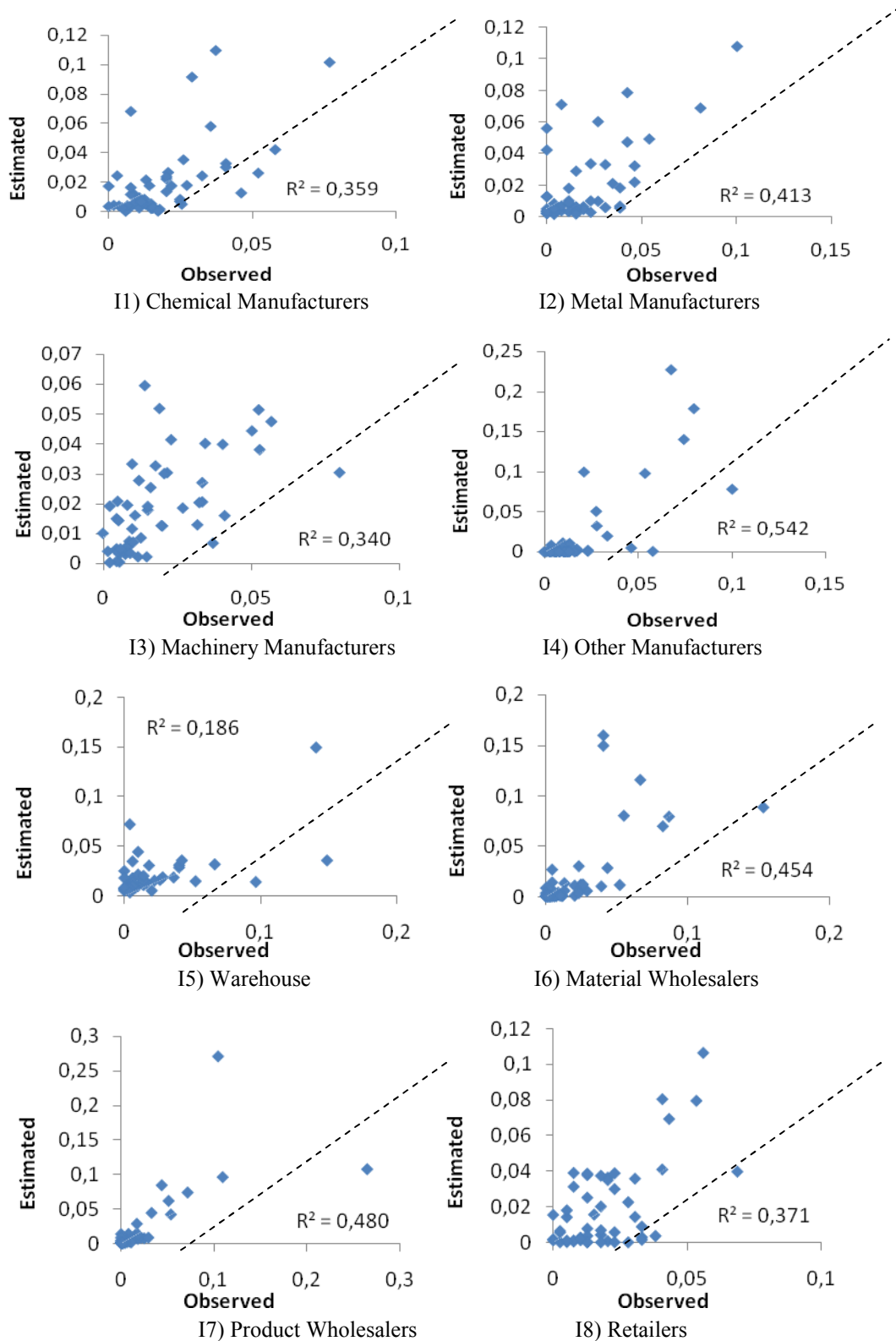
In Figure 4, X axis is the zone choice proportion in observation and Y axis is the zone choice proportion in estimation. Each point in the Figure 4 is represented for each zone. In which, the zone choice proportion in observation is calculated by the number of samples which choose each zone from data source divided the total number of samples. In addition, the zone choice proportion in estimation is calculated based on the number of samples which choose each zone in estimation results divided the number of samples.

6. CONCLUSIONS AND RECOMMENDATIONS

This study has proposed an approach for the enterprise location choice model by a Multinomial Logit Model in an urban area. In addition, the paper also indicate that the location choice decision of enterprises depends on the number of employees in a particular enterprise, transportation cost of each enterprise and the attributes of the zone such as the size of the population and the number of employees in the zone. Moreover, the results suggest that enterprises prefer to locate in zones that have a higher population density and a higher number of employees. Furthermore, the result clarifies the factors that play a key role in the decisions made by companies in selecting a location.

The results of this study can be better in future studies on firm location choice models with considering the location factors that are measured at firm level. The obtained results still leave ample room for improvement because the present study not only is limited to a small data set for the estimation but also not considering the risks of model in over-specified cases. It is expected that a better model performance will be achieved with an improved, larger set of data and specific structures.

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DIVERSITY OR SPECIALIZARION? UNDERSTANDING KNOWLEDGE SPILLOVER MECHANISMS IN CHINA

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Abstract

China's rise to the top echelons of the world's economies was accompanied by an expeditious growth in domestic patent applications. Not surprisingly, this phenomenon has spawned a growing literature trying to sort out the determinants of patented research in China. However, mostly due to data limitations, many of the papers on this topic use aggregated innovation data at the industry, prefecture, or province levels. In this paper, we examine the empirical validity of important theories of knowledge spillover in the context of China at a micro-level, using a firm-level panel dataset comprised of publicly traded companies listed in the Shanghai and ShenZhen Stock Exchanges during the 2006-2010 period. Our study sheds light on whether locating near innovative firms increases patenting activity in general, regardless of the industry membership of these neighboring firms. We also explore how industry makeup, measured by the number of firms in the same or different industries, affects firm-level patenting activity. Our econometric results show that the number of patent applications by firms in close geographic proximity of a firm of interest has a significant and positive impact on that firm's successful patent applications. In addition, we find that proximity to firms in the same industry reduces innovation while locating near firms from different industries stimulates innovation.

1. Introduction

China's swift rise as a global economic power in recent decades has been associated with an equally impressive increase in the number of patented innovations. The number of granted patents reportedly rose from 138 in 1985 to over 200,000 in 2005, to more than 800,000 in 2010 (China Statistical Yearbook of Science and Technology 2019; Yueh 2009). Consequently, several studies have sought to understand the mechanisms of technological innovation in China. These papers have mostly focused on the effects of trade and foreign direct investment (FDI), research and development (R&D), skilled labor, and type of firm ownership. We empirically explore the impact of inter-firm knowledge flows among neighboring firms, using data from a broad set of industries in China. Our focus on firm-to-firm knowledge spillovers in China is premised on the Marshallian and Jacob spillover theories that the spatial clustering of firms from the same or different industries can prompt innovation (Xie et al. 2019; Zhu et al. 2019). Most of the studies investigating knowledge spillover in China, use higher levels of data aggregation, such as province, prefecture/city-level data, which constitutes an important limitation because the flow of knowledge permeates across border lines via multiple modes of diffusion including from firm to firm. Also, the level of interdependence among firms within a given special scale may dictate the degree and extent of knowledge spillover (Glaeser et al. 1992).

We study knowledge diffusion in China at a more micro-level, using firm-level data, with the goal of answering two specific research questions. The first research question explores the effect of pure spatial proximity between firms on knowledge spillover, regardless of industry composition. Knowledge spillover can create a snowball effect that increases overall

productivity, product quality, operational efficiency, and market competitiveness within a region synergistically. The second research question investigates the effect of industry makeup on patent applications at the firm level within a given area. The rest of this study is organized as follows. The second section provides a background and summarizes the existing literature. The third section discusses the data and data sources used in this study. The fourth section outlines the empirical methods. The fifth section presents our results, and the sixth section concludes.

2. Literature Review

2.1. MAR and Jacobs knowledge spillovers

The creation and spread of knowledge have been popular topics for a long time. A number of studies in developed economies (mainly US, Japan, and the European countries) have found evidence that geographic proximity drives knowledge diffusion (e.g. Jaffe 1989; Audretsch and Feldman 1996a; Aldieri 2011; Bottazzi and Peri 2003) in support of two leading theories of intellectual spillovers. The Marshall-Arrow-Romer (MAR) theory of spillover argues that firms in the same industry will experience a higher knowledge spillover if they are located close to each other. The Jacobs spillover theory, on the other hand, argues that firms in different industries will experience a higher level of knowledge spillover if they are located close to each other. The Jacobs theory specifically argues that firms within *complementary* industries benefit from knowledge spillover. It is harder to measure complementary relationships between firms. In our study, we simply consider the number of firms that are *not* in the same industry as a measurement for Jacobs spillover. As more firms enter the complementary supply chain, more knowledge spillover will occur. In other words, MAR focuses on common industry knowledge spillover while Jacobs focuses on diversity-driven knowledge spillover. MAR spillover is often referred to as specialization spillover and the Jacobs spillover as diversity spillover. The two types of spillovers are not mutually exclusive; it is possible that both types of knowledge diffusion can be observed at the same time. The evidence in support of one or the other theory is dependent, in part, on how industry and geographic clusters are specified and how knowledge spillover is defined and measured: economic growth indicators, productivity measures, or innovation indicators (Beaudry and Schiffauerova 2009). Jacobs spillover was frequently detected when industry specifications are at a medium level of detail (represented by 3-digit industry code). On the other hand, there seems to be higher level of MAR detection when industries are more broadly defined (at 1- or 2-digit level). This sort of difference in effects is also observed across industry types: high-tech, medium-tech, low-tech, and service industries. Across these different types of industries, MAR spillover was observed to be significant often in low- and medium-tech industries while Jacobs spillover was observed to be significant in high-tech industries. Service industries showed the lowest evidence of significance in both the MAR and Jacobs spillovers. The next most common source of heterogeneity in spillover type is associated with how the geographic unit is defined – from the broadest definition of a geographic unit being at the state/provincial level to the smaller units being at the counties, labor zones, zip-code levels, and MSA levels. The probability of detection of both MAR and Jacobs spillover increases as the geographic unit specifications become smaller.

2.2. Determinants of innovation in China

Several studies have tried to explain the patent boom mentioned above. In particular, FDI and trade have been found to significantly correlate with knowledge spillover in China at the province, city, and industry levels (e.g., Ning et al 2016; Fu 2008; Liu and Buck 2007). FDI serves as a conduit of knowledge transfer from multinational corporations to their local subsidiaries and it crowds in financial resources, new technologies, and skilled laborers (Fu 2008; Chuang and Hsu 2006; Hu and Jefferson 2009; Liu 2002; Yueh 2009; Yang and Lin 2011; Gao 2004; Huang and Wu 2012; Shang et al. 2012; Ning et al. 2016; Lin et al. 2009). Per Eun et al. (2006), FDI-driven knowledge spillover is commonly observed and a normal phenomenon in fast developing countries like China. While FDI gives domestic firms access to new knowledge, many studies have found that industries and regions must muster a

minimum level of innovation absorbability before any knowledge spillover can be observed (Huang et al. 2010; Fu 2008; Yang and Lin, 2011; Liu and Buck, 2007). Some studies have found no relationship between FDI and innovation (Shang et al., 2012) or a negative one (Liu et al. 2010). Liu and et al (2010) argue that increased FDI flows to local firms in the same industry may heighten competition which, in turn, dampens firms' appetite for risky forms of investments such as innovation. Their analysis is, however, confined to a sample of firms in Beijing's Zhongguancun Science Park over the period 2000-2003.

Researchers have found a positive and significant spillover effect from university and research institutions to industries (e.g., Shang et al., 2012). Per Acs et al (1994), the innovation spur from public research institutions is mostly captured by smaller firms; larger firms were found to benefit mostly from their own R&D investment (Acs et al. 1994). These findings are intuitive in the sense that smaller firms are generally unable to undertake their own innovation and therefore tend to rely more heavily on knowledge generated from the public sector and research institutions. Larger firms on the other hand may be deep-pocketed enough to carry out their own R&D investment on innovation. For China, however, because of the large gap between public and private innovation research, some studies have argued that the spillover between the two may not be as significant as has been found in developed countries. Huang and Wu (2012) indicate that most of the technology patents are put forth by universities and public research institutions and that, in the case of nanotechnology, firms in China have not been able to capitalize on R&D from public research institutions.

Several resource-related characteristics such as R&D, skilled labor, and capital intensity have also been found to be critical inputs to the innovation production function (Lucking et al., 2018; Ning et al. 2016; Huang and Wu 2011; Yueh 2009; Yang and Lin 2011; Rho and Moon 2014; Chang and Sam 2015; Carrion-Flores et al. 2013). More skilled workers are found to have a positive and significant effect on innovation. For example, Shang et al. (2012) find that skilled workers have a more pronounced effect on innovation for research institutions than for firms. They speculate that the reason behind this observation is that research institutions are more interested in novel technological directions (inventor patents) which require more highly skilled workers. Firms, on the other hand, are more interested in perfecting existing processes and products, hence tend to focus on less innovative (design and utility) patent types which require fewer skilled workers.

More closely related to our work are the studies of Li et al. (2019) and Wang and Wu (2016). Li et al. (2019) examine the spillover effect of university research on firm-level innovation, measured by patents. Like our approach, the distances between firm headquarters and nearest research universities are calculated using ArcGIS. Their results show that patent applications by firms are inversely related to their distance to the nearest university and positively related to the research capability of nearby universities. Our research focuses on firm-to-firm rather than university-to-firm knowledge diffusion. Wang and Wu (2016) find evidence that "geographical proximity plays a significant role in knowledge spillover and diffusion" among domestic Chinese firms. However, this study is confined to only one industry (Electronics) and covers one year (2009). Also, in the same vein of research as ours, Rho and Moon (2014), Wang et al (2014), and Shang et al. (2012) empirically study spatial dependence in province-level innovation in China using different types of spatial weight matrices to account for distance between provinces. Rho and Moon (2014) find evidence of interdependence in regional innovation up to a distance of 2,000 kilometers between provincial capitals. Unlike the studies above which, for the most part, are based on regional or industry-level data or are limited to a particular sector, we analyze knowledge flows between neighboring firms from a broad panel of industries in China. As such, our study significantly adds to the important body of literature on knowledge spillover in China.

3. **Data**

We collected and aggregated our data from several sources. This resulted in an unbalanced panel of 1,654 firms that are listed either on the Shanghai Stock Exchange or the ShenZhen Stock Exchange for the years 2006-2010 during which data on all variables was available. Fifteen industries are represented in our data (Table A1 in appendix). Our dependent variable (patents) was obtained from the China National Intellectual Property Administration

(CNIPA), along with the addresses of the patent assignee names. Chinese patents can be divided into three main types: invention, utility, and design. Invention patents are similar to utility patents in the US. Invention patents must demonstrate precedence of discovery or meaningful improvement of a previous process or product innovation. The protection length for invention patents is 20 years whereas for utility and design patents it is 10 years (Moga, 2017). Because utility and design types of patents do not go through an examination process and are not considered to be *innovative* ideas per se, we only consider the invention patents which constitute about half of all patents.

Figures 1 and 2 display, respectively, the spatial distribution of firms in our sample and matched patents in 2010.

Figure 1: Spatial distribution of sample firms
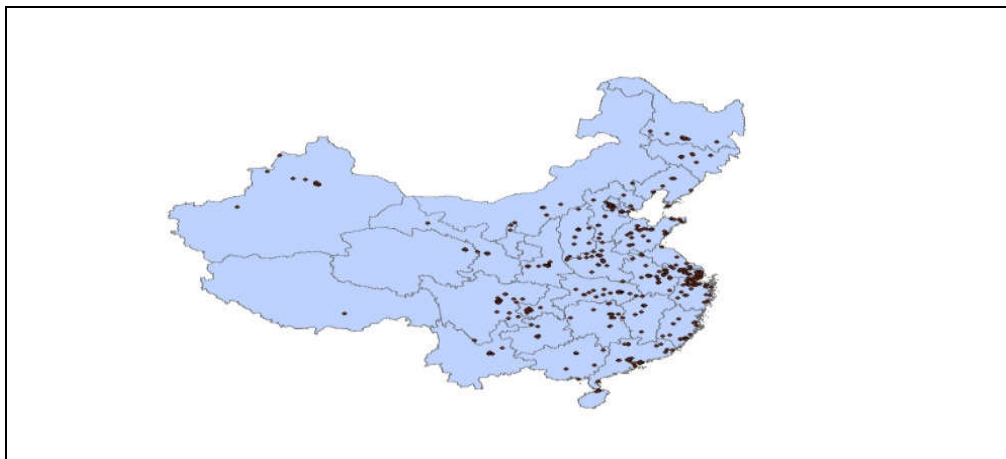
Source: Shanghai Stock Exchange or the ShenZhen Stock Exchange

Figure 2: Spatial distribution of patents
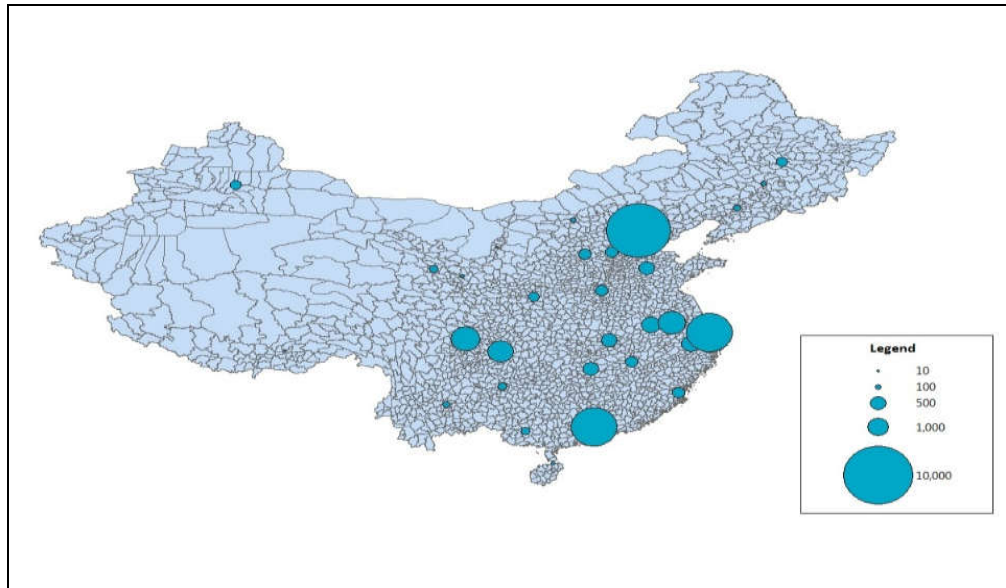
Source: China National Intellectual Property Administration

The figures show that there are a few spatial clusters where we observe most firms and patents: northeastern region, southern coastal region, and central/east coastal region. These clusters are the locations of three megacities in China: Beijing (northeast), Shanghai (central/east coastal), and ShenZhen (south/coastal). The largest science parks are also found in these three regions; we use fixed effects to accounts for the science parks. Patents were matched to each firm based on information reported in the patent application. One potential limitation of our analysis is that it assumes that all innovation within a firm is taking place at the recorded patent assignee/firm address which may not be the case. It is possible that some of the firms have subsidiary facilities, located distantly from the assignee address, that generate patentable innovation. Unfortunately, our data is not detailed enough to identify the

exact location where the innovation is actually taking place. More information regarding matching methods and accuracy check can be found in the paper published by He et al., (2018). He et al., (2018) published a paper on the method used and accuracy check regarding the matching of patents to companies that own them. The authors also made the matched patent data publicly available to other researchers. We obtained all firm level data from the WIND Financial Terminal (i.e. R&D expenditure, capital expenditure, sales, profit, type of ownership, number of workers, average inventor per patent). We calculated R&D intensity as firm level R&D spending divided by total sales, and capital intensity as capital expenditure divided by total sales. We take the log of profit and number of workers due to the skewness and large range of these two variables across different firms. We control for state ownership and foreign ownership. State ownership was computed as the share of stock owned by the State divided by total number of outstanding stocks; foreign ownership was calculated likewise as the share of stocks owned by foreigners. We obtained all prefecture level variables from the China Economic and Social Development Statistics Database. Provincial data were retrieved from National Bureau of Statistics of China (NBS).

Tables 1 and 2 presents the variable definitions and summary statistics of the data, respectively. Several data constraints lead to the limitation of the study sample to the period 2006-10 and prevented us from directly controlling for FDI and skilled workers in our estimations. First, data for firm-level R&D expenditure is not available until 2006. The need to control for R&D, one of the most important inputs to the generation of knowledge, explains the beginning of the sample period in 2006. Second, our dependent variable, matched patent data, ends in year 2010. With respect to FDI data, it was mostly retrieved from the China Statistical Yearbook and provincial statistical yearbooks in the early 1990s. However, since 1996, only FDI data for larger firms and from select industries is available to researchers (Zhou et al. 2002; Hericourt and Poncet 2009; Xu and Sheng, 2011). Firm-level FDI data collected and made available by the World Bank Investment Climate Surveywas limited to the period of 1999-2003 and was only done in selected cities and provinces (Hericourt and Poncet 2009; World Bank 2003). In other words, the available FDI firm level data falls out of the range of our study period and does not encompass all regions. While we do not have a firm-level FDI control, we believe that the inclusion provincial and science park fixed effects in our regressions should mitigate the problem to a large extent since the studies at a more aggregated level indicate that FDI varies across regions with flows mostly coastal provinces and megacities (Su and Jefferson, 2012; Tanimoune et al., 2013; Zhang and Roelfsema, 2014).

Detailed information at the firm level is very limited in the case of China which explains why current studies that have skilled workers as a control are either at an aggregated level (Ning and Li 2016; Shang et al 2012; Fu 2008) or only use select industries (Liu et al 2010). Liu et al (2010) use the presence of returnee entrepreneurs as a proxy for skilled labor among a set of high-tech industries in Beijing's Zhongguancun Science Park over the period 2000-2003. For lack of data on skilled workforce at the firm level, we include the number of workers and the average number of inventors per patent by firm in our regressions. The unique Hukou System in China can also serve as a proxy for skilled labor. Hukou is the internal passport system that restrict free labor flows within the country. Unlike most of the population whose residence is restricted to their birthplace, highly educated Chinese citizens tend to experience little to no internal migration restrictions (Wu and Treiman 2007; Chan and Zhang 1999; Fu and Gabriel 2012). In this case, we are referring to movements from a lower tier location to a higher tier location such as rural to urban, small city to medium/large size cities, or medium to large cities. Generally, the barrier of migration can be lowered when the expected contribution of an individual is high. The effect of the Hukou system on internal migration in China has been studied heavily by many researchers.

Table 1: Variable Definitions

Variable	Variable Description
inventor	Number of successful inventor patent applications submitted by firm i at time t
ninventor5	Total inventor applications submitted by neighboring firms within 5km of radius at time t around firm i

ninventor20	Total inventor applications submitted by neighboring firms within 20km of radius at time t around firm i
ninventor35	Total inventor applications submitted by neighboring firms within 35km of radius at time t around firm i
ninventor50	Total inventor applications submitted by neighboring firms within 50km of radius at time t around firm i
ninventor100	Total inventor applications submitted by neighboring firms within 100km of radius at time t around firm i
ninventor200	Total inventor applications submitted by neighboring firms within 200km of radius at time t around firm i
ninventor300	Total inventor applications submitted by neighboring firms within 300km of radius at time t around firm i
marlevel5	Number of firms in the same industry within 5km of radius at time t around firm i
marlevel20	Number of firms in the same industry within 20km of radius at time t around firm i
marlevel35	Number of firms in the same industry within 35km of radius at time t around firm i
marlevel50	Number of firms in the same industry within 50km of radius at time t around firm i
marlevel100	Number of firms in the same industry within 100km of radius at time t around firm i
marlevel200	Number of firms in the same industry within 200km of radius at time t around firm i
marlevel300	Number of firms in the same industry within 300km of radius at time t around firm i
R&D Intensity	R&D Intensity = R&D expenditure/Sales. To get percentage points R&D intensity is multiplied by 100.
State Ownership	State Ownership = Number of State-owned stocks/total issued stocks
Foreign Ownership	Foreign Ownership = Number of Foreign-owned stocks/total
Capital Intensity	Capital Intensity = Capital expenditure/Sales
Profit	Total amount of profit measured in 10000 observed by firm i at time t
Workers	Total number of workers firm i has at time t
Capital Expenditure	Total amount of capital expenditure by firm i at time t
Average Inventor	Average number of inventors per patent by firm i at time t

We will not go into details on this specific topic since it is not the focus of our research. The migration patterns for more educated groups tend to be toward larger cities or megacities where there is greater concentration of human capital, better local amenities, and employment opportunities (Fu and Gabriel 2012; Fan 2002). Hence, the combination of the average number of inventors per patent, science park and regional fixed effects will capture the effects of skilled labor on firm innovation in our models. It should also be noted that, while skilled workers are a main input of innovation for research institutions, their effect on indigenous firms is unclear in the case of China (Shang et al., 2012) as discussed in the previous section.

4. <u>Methods</u>

We follow a two-step method similar to that outlined by Wallsten (2001). First, we used ArcGIS software to plot each firm's location using their address from the CNIPA database, latitude, and longitude coordinates. Once we pinpoint the location of a firm, we use a series of radii to draw a circular-shaped-buffer around it in such a way that it is the center of the circle. The series of radii we used in our study are 5, 20, 25, 50, 100, 200, and 300 kilometers (km). Key variables are derived within each buffer (i.e., control for total number of firms, total number of patents, total R&D spending, number of workers, and number of firms in the same industry as centering firm i with respect to each increase in the radius). This sequential widening of the buffer zone allows us to investigate how the effects of the variables change marginally as distance to the centering firm is increased.

Table 2: Summary Statistics

Variable	Mean	Std. Dev.
Inventor	35.018	281.468
ninventor5	129.141	666.538
ninventor20	458.209	1155.714
ninventor35	551.212	1265.729

ninventor50	575.367	1280.325
ninventor100	723.840	1431.437
ninventor200	1062.843	1538.448
ninventor300	1333.045	1599.353
marlevel5	1.692	1.265
marlevel20	4.020	4.923
marlevel35	5.297	6.839
marlevel50	5.973	7.332
marlevel100	8.790	9.496
marlevel200	18.095	19.206
marlevel300	27.247	27.079
R&D Intensity (percentage points)	1.355	4.154
State Ownership	0.197	0.229
Foreign Ownership	0.01986	0.0845
Capital Intensity	0.092	0.147
Profit (CNY 1,000)	609,000	4,860,000
Capital Expenditure (CNY 1,000)	1,070,000	7,850
Workers	8,177.415	28,760.91
Average Inventor	3.424	2.399

Once we obtained our key variables within each buffer, we applied a panel data method to estimate how spatial proximity and industry makeup within an assigned geographic boundary affect knowledge spillover in China at the firm level. Specifically, we explore our research questions using the reduced form model:

$$P_{itr} = \alpha_r + \beta_r Pat_{itr} + \delta_r C_{itr} + \theta_r X_{itr} + \tau_r Per_{ir} + \lambda_{tr} + \varphi_{ir} + \rho_{ir} + s_{ir} + \varepsilon_{itr} \qquad (1)$$

where the radius r = 5, 20, 35, 50, 100, 200, 300 km, the dependent variable, P_{itr}, is the number of successful patent applications submitted by firm i at time t located in the buffer with radius r. Pat_{itr} is the patent count within radius r around firm i at time t. Our key variable of interest and other control variables within each buffer will change as the area changes. C_{itr} represents the number of firms within the same industry as the centering firm i and captures the effect of industry makeup within radius r. X_{itr} are the firm level controls; Per_{ir} are the prefecture-level controls; λ_{tr} are the time fixed effects; φ_{ir} are the industry fixed effects; ρ_{ir} are the provincial fixed effects; s_{ir} are the science park fixed effects; and α_r, β_r, δ_r, θ_r, τ_r are parameters to be estimated with β_r and δ_r being the main parameters of interest in our reduced form model.

The key variables we control for at the firm level are the number of workers, R&D intensity, capital intensity, profit, ownership information, and the average number of inventors per patent. These control variables are chosen based on previous work as discussed in the literature review. We control for firm profits because economists have argued that a firm's internal resources are an important determinant innovation due to asymmetric information related to innovation research. That is, innovators have more information about the likelihood of success of a research project and the risk of intellectual property infringement precludes full disclosure to potential investors. Such asymmetric information may lead investors to demand a premium in order to finance research projects (Hall 2002) making external financing more expensive than internal financing (profits). We include two interaction terms (average number of inventors*R&D and average number of inventors*capital intensity) in order to capture the synergistic effects between innovation inputs within firms. We include prefecture GDP in order to control for the possibility that firms are sorted into an area due to the first two drivers of Marshallian agglomeration that were discussed earlier: decrease in the cost of goods (up and down the supply chain) and workers. The reason, prefecture GDP can capture the value generated by the local inputs such

as establishments and size of labor pool in each prefecture. We control for regional fixed effects in our estimations to capture time-stable heterogeneity across regions such as provincial policies that may affect firm patenting behavior. We consider a total of 31 regions: 22 provinces: Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, and Zhejiang; 4 major municipalities: Beijing, Chongqing, Shanghai, and Tianjin; and 5 autonomous regions: Guangxi, Inner Mongolia, Ningxia, Tibet, and Xinjiang. Science park dummy variables control for the effect of high concentrations of innovative firms within a small area thanks to policies of the central government (Walcott, 2002). Lastly, industry and time fixed effects are added as controls for any time trends and heterogeneity across industries.

We ran a series of regressions using key variables calculated for each buffer. The first regression was ran using a 5km radius. The second regression was ran using a 20 km radius, while controlling for the data from the 5km of radius. In other words, the second regression contains patent data from both the 5km and 20km radius buffers. Controlling for the smaller buffer allows us to see the incremental effect of neighboring patents beyond the first buffer on centering firm i's patent activity. The next few regressions were ran using 35, 50, 100, 200, and 300 km of radius utilizing the same approach. For each additional regression, we expand to the next buffer size while controlling for the smaller areas to estimate the incremental effect of patent counts from the additional neighboring firms.

One significant challenge for our regression model is the presence of endogeneity with respect to neighboring patent count. Our dependent variable is the number of successful patent applications submitted at time t by firm i. Our first covariate of interest is the total number of successful patent applications submitted by all other firms within radius r at time t around centering firm i. Theoretically, if we expect that centering firm i's patenting behavior is influenced by neighboring firms' patent applications then, according to this logic, we should expect that the other direction of the relationship is also true. That is firm i's patenting behavior should, in turn, also influence neighboring firms' patenting activities. We rely on an instrumental variable approach (IV) to address this reverse causality. We use two variables to serve as our instruments: workforce of neighboring firms and R&D expenditure by neighboring firms around firm i at time t within radius r. Both R&D and workers are important inputs that produce patentable innovation. Thus, we expect the instruments to be highly correlated with the endogenous variable. At the same time, other firms' inputs (R&D spending and size of workforce) should not directly affect the centering firm's innovative activity. One may argue that the centering firm could alter its innovation policy after observing neighboring firms' input decisions. While it is possible that firm i may increase its own innovation input (such as investing more in R&D or delegating more workers toward innovation) after observing neighboring firms' R&D decisions and workforce changes, this represents an indirect effect through the endogenous variable. Therefore, it is reasonable to conclude that the instruments used do not directly explain the dependent variable. Test of relevance and exogeneity are presented and discussed later in the paper.

5. **Results and Discussion**

Our main regression results can be found in Tables 3 and 4. In Table 3, we present our results for radius stacking in order to answer our first research question. Table 4 presents the results for progressively larger radii but without controlling for the smaller areas each time a larger radius is used. Regression results from Table 3 answer our second research question by including the number of firms that are in the same industry as centering firm i within radius r at time t; this serves as our MAR spillover indicator. Table 3 column 1 presents our first regression results for the 5km radius around each firm.

Table 3: Regressions for Progressively Larger Firm Neighborhoods

Variables	(1) R=5	(2) R=20	(3) R=35	(4) R=50	(5) R=100	(6) R=200	(7) R=300
ninventor300							-0.000571
							(0.0261)
ninventor200						0.00865	0.00878
						(0.0217)	(0.0294)
ninventor100					-0.0328	-0.0393	-0.0395
					(0.0697)	(0.0729)	(0.0720)
ninventor50				0.0871	0.146	0.140	0.141
				(0.179)	(0.235)	(0.234)	(0.233)
ninventor35			-0.0159	-0.113	-0.140	-0.135	-0.136
			(0.0332)	(0.204)	(0.222)	(0.221)	(0.221)
ninventor20		-0.0142	-0.00112	0.0106	0.0119	0.0106	0.0107
		(0.0258)	(0.0383)	(0.0461)	(0.0469)	(0.0467)	(0.0467)
ninventor5	0.118*	0.130*	0.116*	0.116*	0.121*	0.120*	0.118*
	(0.0672)	(0.0673)	(0.0679)	(0.0678)	(0.0678)	(0.0675)	(0.0672)
R&D Intensity$_{t-1}$	10.04**	8.534**	10.31***	10.19***	10.18***	10.01**	10.04**
	(3.944)	(3.810)	(3.914)	(3.910)	(3.931)	(3.936)	(3.944)
Log (Workers)	45.59***	41.53***	44.49***	44.57***	45.30***	45.52***	45.59***
	(10.17)	(10.21)	(9.808)	(9.845)	(10.07)	(10.11)	(10.17)
Log (Profit)	0.410	0.469	0.448	0.450	0.414	0.414	0.410
	(0.962)	(0.922)	(0.956)	(0.954)	(0.963)	(0.960)	(0.962)
Capital Intensity	-30.27	-28.27	-26.66	-30.23	-30.68	-30.26	-30.27
	(96.78)	(94.05)	(95.35)	(95.62)	(96.17)	(95.99)	(96.78)
State Ownership	-38.73	-28.61	-33.32	-32.47	-37.59	-38.48	-38.73
	(35.58)	(32.49)	(33.28)	(33.27)	(35.29)	(35.38)	(35.58)
Foreign Ownership	-138.6	-118.4	-138.5	-154.9	-134.7	-137.2	-138.6
	(184.7)	(187.5)	(176.9)	(181.6)	(185.2)	(185.4)	(184.7)
Average Inventor	-2.135	-1.572	-1.894	-2.045	-2.103	-2.129	-2.135
	(3.483)	(3.318)	(3.425)	(3.439)	(3.461)	(3.455)	(3.483)
Average Inventor * R&D Intensity$_{t-1}$	0.569	0.547	0.554	0.594	0.583	0.576	0.569
	(0.917)	(0.882)	(0.912)	(0.914)	(0.919)	(0.917)	(0.917)
Average Inventor * Capital Intensity	8.118	8.139	7.930	8.694	8.073	8.133	8.118
	(21.59)	(20.81)	(21.33)	(21.37)	(21.52)	(21.47)	(21.59)
Prefecture GDP	0.00123	-0.000420	0.000664	0.000565	0.00126	0.00119	0.00123
	(0.00447)	(0.00416)	(0.00418)	(0.00419)	(0.00448)	(0.00447)	(0.00447)
Observations	879	879	879	879	879	879	879

Notes: all regressions include year, firm, industry, province/region, and science park fixed effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The key variable of interest, ninventor5, indicates how total neighboring patents within a 5km of radius affect the centering firm patenting behavior. Our results show that an increase of 10 patent applications collectively by the neighboring firms (about 7.75% of the sample mean--see Table 2) increases center firm's patent applications by about 1.2 patents (about 3.4% of the sample mean) on average. In regression 2, we increase the radius to 20km. Again, we control for the effect on innovation by neighboring firms within 5km of radius. Controlling for the smaller radius allows us to investigate the incremental effect of the increasing distance--above and beyond the effect of innovation of neighboring firms within the 5 km radius. Hence, the marginal effect reveals the effect of neighboring patents on firm i's patenting behavior from 5km – 20km. We find that the neighboring firms' patenting activities have a positive and significant effect within radius of 5km, but the effect is no longer significant outside of the 5km radius. This observation remains when we increase the radius to 35, 50, 100, 200, and 300km and indicates that, while firms benefit from spatial

knowledge spillover, the effect does not improve with increasing in distance. Knowledge spillover could not be detected outside of 5km of radius in that all the incremental marginal effects outside of the 5km are insignificant.

Our results can be counterintuitive at first glance. As we increase the radius, a bigger area is being considered; therefore, more firms and more patents would be observed within the area. The knowledge spillover literature has suggested that more neighboring patents should increase other firms' patent applications (e.g. Jaffe et al.1986; Aldieri 2011; Bottazzi and Peri 2003). However, many of these studies did not consider how an incremental increase in distance between firms affects innovation activities. Our results have shown that while there is knowledge spillover, it's effect in terms of stimulating patentable research is very much limited by geographic proximity in China. Most of the studies that were done in developed countries have found the effect of knowledge spillover diffuses to a larger scale. For example, Bottazzi and Peri (2003) studied knowledge spillover in European regions and found that knowledge spillover diffuses up to a 300km radius. Audretsch and Feldman's (1996b) findings about the interaction between knowledge spillover and industry life cycle can provide a possible explanation for the limited geographical reach of knowledge spillover found in our results. They argue that knowledge spillover spurs innovation within a small area at the beginning of an industry's cycle because the lack of accepted standards and a high degree of product uncertainty during the early stages of an industry's life cycle make it harder for firms to know what consumers desire without proximity to knowledge sources. In other words, "tacit knowledge" plays an important role in the early stage of industrial development and it requires physical proximity to obtain it. Once an industry matures, the uncertainty about product standards and consumer preferences are much reduced, hence finished products become a springboard to spread knowledge farther geographically. China is still going through the process of economic transformation and has yet to reach full economic maturity, which could explain our empirical result that the area of effect in terms of knowledge spillover is significantly smaller than in developed economies. Our results suggest that the current studies of knowledge spillover in China that rely on province level data are too broadly aggregated.

Table 4: MAR Regressions

Variables	(1) R=5	(2) R=20	(3) R=35	(4) R=50	(5) R=100	(6) R=200	(7) R=300
ninventor	0.182**	0.0350	-0.0172	-0.0144	-0.00531	-0.0102	-0.0162
	(0.0793)	(0.0345)	(0.0294)	(0.0273)	(0.0237)	(0.0202)	(0.0194)
marlevel	-12.48	-9.582***	-5.343**	-5.286**	-3.184*	-1.335	-0.707
	(11.25)	(2.943)	(2.336)	(2.173)	(1.673)	(0.937)	(0.713)
R&D Intensity$_{t-1}$	8.584**	7.812**	10.27***	9.615***	8.412**	7.982**	8.672**
	(4.018)	(3.580)	(3.700)	(3.658)	(3.573)	(3.533)	(3.576)
Log (Workers)	40.75***	40.54***	43.65***	42.79***	41.54***	40.58***	42.73***
	(10.75)	(9.722)	(9.143)	(9.230)	(9.489)	(9.640)	(9.494)
Log (Profit)	0.544	0.474	0.332	0.356	0.374	0.327	0.278
	(0.971)	(0.865)	(0.906)	(0.894)	(0.871)	(0.854)	(0.873)
Capital Intensity	-34.01	-41.56	-28.15	-26.44	-17.67	-35.00	-40.76
	(98.22)	(88.73)	(89.92)	(89.34)	(88.34)	(87.24)	(87.59)
State Ownership	-26.08	-34.11	-40.08	-38.33	-35.92	-34.84	-37.83
	(34.26)	(30.35)	(31.21)	(30.90)	(30.49)	(29.88)	(30.26)
Foreign Ownership	-111.5	-262.5	-245.2	-233.9	-229.7	-210.5	-212.8
	(196.2)	(173.6)	(155.0)	(157.7)	(167.4)	(172.6)	(166.9)
Average Inventor	-1.879	-1.090	-1.227	-1.012	-1.113	-1.035	-1.286
	(3.486)	(3.123)	(3.229)	(3.191)	(3.106)	(3.059)	(3.094)
Average Inventor* R&D Intensity$_{t-1}$	0.928	0.624	0.279	0.284	0.288	0.308	0.296
	(0.929)	(0.837)	(0.856)	(0.844)	(0.820)	(0.803)	(0.811)
Average Inventor* Capital Intensity	8.685	7.081	5.660	5.131	4.800	7.915	8.886
	(21.82)	(19.54)	(20.09)	(19.90)	(19.51)	(19.22)	(19.38)
Prefecture GDP	0.00145	0.00362	0.00331	0.00274	0.00175	-0.000344	-0.000376
	(0.00441)	(0.00420)	(0.00418)	(0.00417)	(0.00420)	(0.00400)	(0.00388)
Observations	879	879	879	879	879	879	879

Notes: all regressions include year, firm, industry, province/region, and science park fixed effects.
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4 allows us to respond to our second research question pertaining to the interaction between knowledge spillover, industry makeup, and geographic proximity. In this table, we no longer focus on the incremental marginal effect with the increase in radius; instead, we show the total effect within a radius. In specification (1) of Table 4, our key explanatory variable (ninventor--total inventor applications submitted by neighboring firms within radius r) is still significant and positive, and the magnitude of the effect is larger than in Table 3: an increase of 10 neighboring patent applications leads to an increase of about 1.8 patent applications for the centering firm, corresponding to about 5% of the sample mean, on average. This result is only significant and positive within a 5km radius.

The MAR effect (coefficient on marlevel) is not statistically significant for the 5 km radius indicating that co-locating in close proximity with firms of the same line of business does not adversely affect the innovation spur. Given the definition of MAR spillover (number of firms that are in the same industry as the centering firm), the way we construct the Jacobs spillover variable (number of firms that are not in the same industry), and since we are controlling for the total number of patent applications by neighboring firms, the coefficient for Jacobs spillover is simply the negative of the MAR (marlevel) coefficient in Table 4. For this reason, the equivalent of Table 4 for the Jacobs spillover measure (instead of MAR spillover) is omitted. Given the size of the coefficient (-12.48), the non-significance of the MAR effect could also be due to lack of statistical power because of the small number of firms. As the radius is increased, we observe a significant and negative effect of MAR spillover (conversely a positive and significant effect of Jacobs spillover) on firm i's patenting behavior in most of the specifications. In specification (2) for example which corresponds to a radius of 20 kms, we find that one additional firm within the same industry decreases the centering firm's patent applications by nearly 9.6 units. This negative effect remains significant as radius increases; however, the magnitude of effect decreases rapidly. Beyond a100km radius, industry makeup is no longer a significant factor that affect firms' patenting behavior.

Together, Tables 3 and 4 indicate the existence of knowledge spillover among Chinese firms; however, this effect is very limited to geographic proximity--5kms--and depends on industry makeup. Concentration of firms in the same line of business within a 100km of radius is detrimental to firm level innovation while having a variety of firms from different industries promotes innovation. Our findings lend support to previous studies that firm diversity is key to innovation stimulus (e.g., Beaudry 2009). We conjecture that the uncertainty from increased competition between alike firms leads to a decrease in high-risk investments such as patentable research. Lucking et al. (2018) find that R&D by product market competitors reduces patenting activity of a firm because of business stealing by the successful innovator. They argue that R&D investments by competitors reduce the marginal benefit of R&D thereby lowering a firm's incentive to invest in R&D itself.

To gauge the validity of our IVs, we present the first stage regression in appendix (Table A2 in appendix). Both instruments are highly significant, indicating relevance. We also present results of the Hansen overidentification test to check on the validity of the exogeneity assumption. The null hypothesis of the Hansen test is that the instruments are uncorrelated with the error term in the main regressions (equation 1). All of our p-values are larger than 10%. In summary, both tests of relevance and exogeneity substantiate our argument of instrument validity.

6. Conclusion

In this study, we investigate knowledge spillover in China using firm-level panel data and ArcGIS to create uniform spatial scales around each firm. Our results provide important insights pertaining to well-known theories of knowledge spillover. First, geographic proximity between firms increases knowledge spillover, a finding that is consistent with previous studies in this realm (i.e. Shang et al. 2012; Aldieri 2011; Glaeser et al. 1992). Second, locating close to firms in the same line of business (indicated by the number of firms in the same industry) deters innovation while being close to firms from other industries stimulates innovation. This observation is in line with theories outlined in Arrow (1959) that competition between firms has a significant adverse effect on innovation. Given that patenting is a risky form of investment that generally requires significant financial and human

resources, decisions that involve patentable innovation are made if justified by a benefit cost analysis. Firms in the same industry and in close proximity are often competing against each other in terms of intermediate goods, workforce, and customers. An increase in the number of firms in the same industry within an area increases competition within the area, which increases the level of uncertainty in future profitability. Once profitability is at risk, risk-adverse firms will not invest in riskier forms of assets (such as innovation), hence fewer patent activities. Locating close to innovative firms increases knowledge spillover, but this effect is only significant in a very small geographic range. The research findings in this study are important for a fast-developing country like China and suggest that to promote and increase innovative activities within Chinese industries, policymakers should foster policies that encourage a diversity of firms in areas that have a high density of firms such as science parks.

7. <u>References</u>

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8. **Appendix**

Table A1: Industries Represented in our Dataset and their Codes

Sector	Code
Farming, Forestry, Animal Husbandry & Fishery	A
Mining	B
Manufacturing	C
Electricity, Heat, Gas and Water Production and Supply	D
Construction	E
Wholesale & Retail	F
Transportation, Storage and Post	G
Information Transmission, Software and IT services	I
Financial	J
Real Estate	K
Leasing and Business Services	L
Scientific Research and Technical Service	M
Water Conservancy, Environment, and Public Facilities Management	N
Education	P
Conglomerates	S

THE POTENTIAL IMPACT OF COVID-19 ON MEGA ENERGY PROJECTS AND LNG SHIPPING INFRASTRUCTURE; THE CASE OF EASTMED PIPELINE

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Abstract

It is a matter of fact that COVID-19 pandemic has brought significant changes in political, economic and social level worldwide. The aim of this paper is to examine the potential impact of the pandemic on the launching of large scale energy projects in Southeast Mediterranean region, and in particular the construction of EastMed Pipeline. During 2020, many energy projects across the globe were postponed and that trend is mainly attributed to: a) the economic recession brought by COVID-19, b) a lack of investment appetite by major energy companies whose financial position was severely hit by the pandemic and the volatile energy prices and c) the switching to the use of alternative energy sources (mainly renewables and hydrogen) in an attempt to minimize the global share of fossil fuels and their emissions, the so-called "energy transition" process. This paper takes into account whether all the above exogenous factors create serious implications to the development of the most important mega energy project of Southeast Mediterranean in terms of energy geopolitics, the EastMed Pipeline. Finally, the paper examines the conflicted geopolitical interests of regional players such as Greece, Cyprus, Israel, Turkey and Egypt, as well as the role of European Union and the United States in the energy equation of Southeast Mediterranean.

Keywords: COVID-19, Economic recession, EastMed pipeline, Alternative energy sources, Southeast Mediterranean, Investments

JEL classification: F10, F51, R41, R42, R48

1. Introduction

The Southeast Mediterranean region and its gas reserves firstly came to the forefront in 2009. Within a decade period, the region had managed to draw the attention of global energy sector as more specifically, the most significant energy companies rushed to acquire the exploitation rights in offshore fields of Cyprus, Israel and Egypt in order to proceed with drilling operations. Despite the fact that the rate of success was quite modest, the region proved to enclose approximately 2 trillion cubic meters (cbm) of natural gas and other hydrocarbons. Based on that, Southeast Mediterranean region has the potential to become an important supportive pillar to the European Union (EU) energy sector as it refers to diversification of energy routes and sources. It is of massive importance though that, this potential energy hub should have to test its viability, price competitiveness and endurance towards other well-established regional producing areas, such as Middle East, US Gulf, Russian Arctic etc.

There has been a lot of discussion on whether the Southeast Mediterranean energy hub would materialize either by taking the form of a pipeline –EastMed- that could connect the proven and future gas reserves of the region with continental Europe, or via LNG exports from a certain regional mega liquefaction plant that could meet global and regional demand under the commercial employment of LNG vessels. Consequently, there has been a lot of controversy about which is the best exploitation strategy.

On the other hand and due to COVID-19 pandemic, global economy seems to enter in a new era of economic instability with numerous worst and best case scenarios, while uncertainty prevails in socioeconomic level. That uncertainty jeopardizes and even postpones

important investments regarding energy projects across the globe. In addition, global energy prices do not seem to be on a recovery mode, as after the initial collapse, they have returned to the stagnant levels of the last five years, prohibiting actually any inception of new investment. Based on the above, there is serious concern about EastMed Pipeline and whether its completion schedule will be adhered to by 2025.

2. **The pandemic's impact on global economy and future prospects**

It is a matter of fact that COVID-19 pandemic has brought an economic recession in 2020 and as it seems, the global health crisis is extending on the first half of 2021. In many aspects, the ongoing economic downturn is even more severe than the global financial crisis of 2008, as depicted in Figure 1, comparable maybe only to the Great Depression of 1929 (Spathi 2020).

Figure 1: Annual rate of change in world GDP 1990-2021*
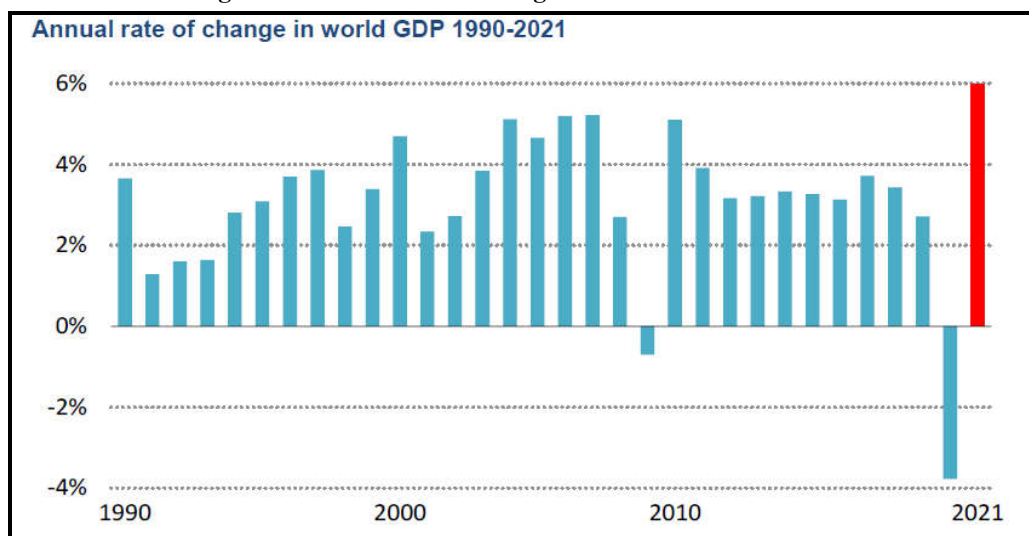
Source: IEA analysis based on economic data from the IMF and Oxford Economics

According to the World Bank and IMF, global GDP contracted by 3.3% in 2020 as depicted in Table 1. Indicatively, the United States (US) economy declined by 3.5% while analysts estimate a cumulative loss of $7 trillion by 2030. In Asia-Pacific region, Japan's economy was also declined by 4.8% while on the contrary Chinese economy grew by 2.3% achieving an economic slowdown as China faces its lowest economic growth since 1976. Furthermore, Indian economy was severely hit by a 8% decline. Eurozone has recorded a historical GDP decline of a massive 6.6% with a huge impact on member countries' economies and a new forthcoming recession (Spain -11%, Germany -4.9%, France -8.2%, Italy -8.9%, Portugal -8.1%, Greece -7.9% and Cyprus -6%).

Table 1. World economic growth 2018 – 2020 (annual percentage change)

Region/Country	Avg 2001-2008	2018	2019	2020
EU (27)	+ 2.1%	+ 2.1%	+ 1.5%	- 6.6%
Japan	+ 1.2%	+ 0.3%	+ 0.6%	- 4.8%
United States	+ 2.6%	+ 2.9%	+ 2.3%	- 3.5%
China	+ 10.9%	+ 6.6%	+ 6.1%	+ 2.3%
India	+ 7.6%	+ 6.8%	+ 4.2%	- 8.0%
Brazil	+ 3.7%	+ 1.3%	+ 1.1%	- 4.1%
Russia	+ 6.8%	+ 2.3%	+ 1.3%	- 3.1%
World	**+ 3.6%**	**+ 3.1%**	**+ 2.5%**	**- 3.3%**

Source: UNCTAD Review of Maritime Transport 2020

The recession of 2020 affected geographical areas and sectors, such as tourism industry as a whole, transport and in particular air transport, which have suffered great losses. Moreover, COVID-19 pandemic and the suspension of any economic activity had a huge negative impact on businesses and households as well. It has to be pointed out though, that an unprecedented determination of governments and central banks (ECB, Federal Reserve, Bank of England and others) is being recorded, in order to take all the appropriate measures to deal

with the pandemic. Their primary strategy is to ensure liquidity and provide low borrowing costs.

2.1. The proposed economic measures and the threat of a new debt crisis

In October 2020 Germany and France, have announced support packages of €10 billion and €20 billion respectively, which aim at companies or enterprises whose economic operations were negatively affected by the pandemic and the consecutive lockdowns. Moreover, the European Central Bank (ECB) is planning to cover the capital needs of EU member countries, extending the €1.35 trillion Pandemic Emergency Purchase Program (PEPP) by €500 billion (Amaro 2021). Of course, there is a lot of concern about a potential "japanification" of the European bond market, since the ECB absorbs the largest proportion of the aforementioned member countries' debts (Kourtali 2021).

In addition, in the United States, the American Rescue Plan called the "Biden stimulus" of $1.9 trillion aims to raise the country's GDP above pre-COVID-19 projections. It is estimated that the Biden stimulus will add a total fiscal support of about 11%-12% of the country's GDP. As it refers to Eurozone, analysts estimate that the total aid to EU's economy will not exceed 6% of its GDP. As it is widely accepted, it took seven years for Eurozone to fully recover from the global financial crisis of 2008, while the United States economy had managed to fully recover in exactly the half time, actually in three and a half years. This time, it is projected that the Eurozone economy will take nine quarters to return to pre-pandemic levels, while the United States economy will take only six quarters, respectively. It needs to be pointed out that there are structural differences between United States and Eurozone's economies.

On the contrary, there are warnings that the widespread spending to support the economies may lead to a massive increase of global debt, which is already at inconceivable levels. Indeed, in 2020 global debt increased by $15 trillion, standing at $277 trillion, or 365% of global GDP (320% in 2019). Moreover, during 2020 global debt have been increased at a much higher rate than economists and international credit institutions were expecting. Indicatively, between 2016 and 2020 global debt had increased by almost $60 trillion, in addition to a $6 trillion increase between 2012 and 2016. The problem lies on the emerging markets and their total debt that stands at $76 trillion, or 250% of their cumulative GDP. As it refers to Eurozone, the ECB has predicted a debt increase; indicatively, Greece's debt will stand over 200% of its GDP, Italy's debt will stand on 160% of its GDP, while Portugal's debt will stand on 130% and France's as well as Spain's debt will both stand on 120% of their GDP. It should be also mentioned that new European non performing loans are estimated to reach €1.4 trillion. For that reason, the IMF which has not stopped supporting government spending to support its economies, has advised that it should be done prudently, in order to avoid a further debt increase.

Severe epidemics traditionally widen the inequality between rich and poor and, as a matter of fact, COVID-19 has contributed the most to the above widening. The massive impact is focused on social matters and the labor sector, as job losses and wage reductions are the main trends. In fact, during 2020, fifteen million people lost their job in Spain, over ten million people in the United States, United Kingdom and France and, over four million people in Germany and Japan, according to OECD data. A Columbia University research depicts that in 2020 poverty levels in the United States were raised by 16.7%, while another research from University of Chicago notes that during the same period more than six million Americans have gone into poverty. On the contrary, according to a Credit Suisse research, it is estimated that the wealth of the world's billionaires, was raised by $3.0 trillion in 2020.

2.2. Forecasts for economic recovery in 2021 and the long-term effects of the pandemic

Despite the aforementioned gloom environment and prospects of global economic recovery, there are some bright examples that provide optimism. For example, China has curtailed the virus early on and was one of the few economies to expand in 2020, by 2.3%. China's economic growth is expected to continue through 2021 by 8.4%, mainly driven by exports and domestic demand. The great Asian power is emerging economically and

geopolitically strengthened against its competitors one year after the pandemic started from its territory (Qin 2021). Moreover, World Bank forecasts that by 2028, China will have overcome United States as the world's largest economy. Furthermore, South Korea and Japan managed to avoid repeated waves of the pandemic through testing and tracing and, likewise they are benefiting from the reviving world trade. Moreover, India is likely to be a key variable for the global economic outlook. In 2020, India's GDP dropped by 8% but the outlook was significantly improved at the end of the year, driven by recovering industrial production. Estimates place India's annual GDP growth in 12.5% in 2021.

Estimates vary however, as the future remains more uncertain than ever. For example, HIS Markit expects modest recovery of 4.6% of economic growth in 2021. IMF from its point of view, estimates a stronger than anticipated growth of 6% GDP in 2021 and a moderate growth of 4.4% in 2022. As it refers to Eurozone's recovery, it is expected to be eventually lower and slower than the initially anticipated and that it will take at least two years for the Eurozone to return to pre-pandemic levels. Finally, a particularly optimistic forecast by Morgan Stanley predicts that global economy will grow by 6.4% in 2021, with emerging markets ahead of European Union and the United States. It seems that accelerating vaccine rollouts and major stimulus packages in many economies have provided a beacon of hope, as depicted on Table 2.

Table 2. Overview of the world economic outlook 2021-2022

Region/Country	2021 GDP projections	2022 GDP projections
United States	+ 6.4%	+ 3.5%
EU-27	+ 4.4%	+ 3.8%
Germany	+ 3.6%	+ 3.4%
France	+ 5.8%	+4.2%
Italy	+ 4.2%	+ 3.6%
Spain	+ 6.4%	+ 4.7%
United Kingdom	+ 5.3%	+ 5.1%
Japan	+ 3.3%	+ 2.5%
China	+ 8.4%	+ 5.6%
India	+ 12.5%	+ 6.9%
Russia	+ 3.8%	+ 3.8%
Brazil	+ 3.7%	+ 2.6%
Saudi Arabia	+ 2.9%	+ 4.0 %
World Output	**+ 6.0%**	**+ 4.4%**

Source: IMF

However, many analysts support that everything will depend on the waves of the pandemic and the virus' mutations. The pessimistic approach focuses on the negative long term impacts of the pandemic in most of the economies. Some indications depict that COVID-19 will be present at least until 2025, affecting global economic activity. Based on the above, the long-term recovery of global economy is still under discussion. According to this approach, until 2025 world economy will suffer great losses based on 2019 levels. Nevertheless, the world must be well prepared for the next unpredictable great pandemic (Fauci 2021).

All things considered, there is an ongoing controversy about whether the day after the pandemic will bring a time of prosperity, consumptionism and technical innovation for the rest of the decade, as exactly happened in the aftermath of the Spanish flu in 1920. This possibility is real, as 2020 proved that the economy and society can thrive, even under adverse conditions. The year of 2021 may be reminiscent of 1921, as analysts estimate that technological innovations, adopted in the midst of a pandemic, such as teleworking technologies and e-commerce, will continue to be sources of profitability and growth once the restrictive measures are lifted. According to analyst firm Cowen Research, more than half of the companies report that they are in the first stage of transition to a purely digital environment.

### 3. **The pandemic's impact on global energy sector and future prospects**

In 2020, global energy demand fell by 4%, the largest annual decline since World War II, as COVID-19 had a huge negative impact on global energy sector. The world's largest producers have been impacted by the pandemic up to different degrees. For example, Saudi Arabian economy, the world's largest oil producer, declined by 4.1%, while Russian economy

was also declined by 3.1% in 2020. As it refers to advanced economies, energy demand fell by over 6% accompanied by a contraction in their economic output. On the contrary, most emerging markets and developing economies have also experienced a decline in energy demand during 2020, albeit less than in advanced economies. China was a notable exception as the only major economy to experience both an increase in economic output and in energy demand in 2020, as energy demand on China grew by 6% on average from pre-pandemic levels. As it refers to India, the country's steep economic slide in 2020 pushed energy demand down by 5%.

COVID-19 pandemic continues to impact global energy demand in the first quarter of 2021. Projections indicate that as pandemic restrictions are gradually lifted and economies recover, energy demand is expected to rebound by 4.6% in 2021. Moreover, if transport demand returns to pre-pandemic levels across 2021, global energy demand will rise even higher, an increase broadly in line with the rebound in global economic activity. Indicatively, as it refers to EU, energy rebound will not begin until the second half of 2021 while, in the United States and due the recent stimulus package, energy demand is projected to increase by 4% in 2021, though remaining 3% below 2019 levels. As economic activity in China is set to further accelerate in 2021, energy demand is expected to grow by 6%, almost 8% higher than in 2019. As it refers to India, the country's economy is expected to bounce back strongly in 2021 and as a result, energy demand is set to rebound by 7%.

All things considered, in 2021 advanced economies are expected to see rapid recoveries in economic output and –consequently- in energy demand across most sectors. Emerging markets are driving energy demand back above 2019 levels as, almost 70% of the projected increase in global energy demand is in emerging markets and developing economies, where demand is set to rise to 3.4% above 2019 levels. On the contrary, energy use in advanced economies is on course to be 3% below pre-pandemic levels. All the above are clearly depicted on Figure 2.

Figure 2: Rate of change of energy demand in 2020 and 2021 energy demand relative to 2019 levels, by region
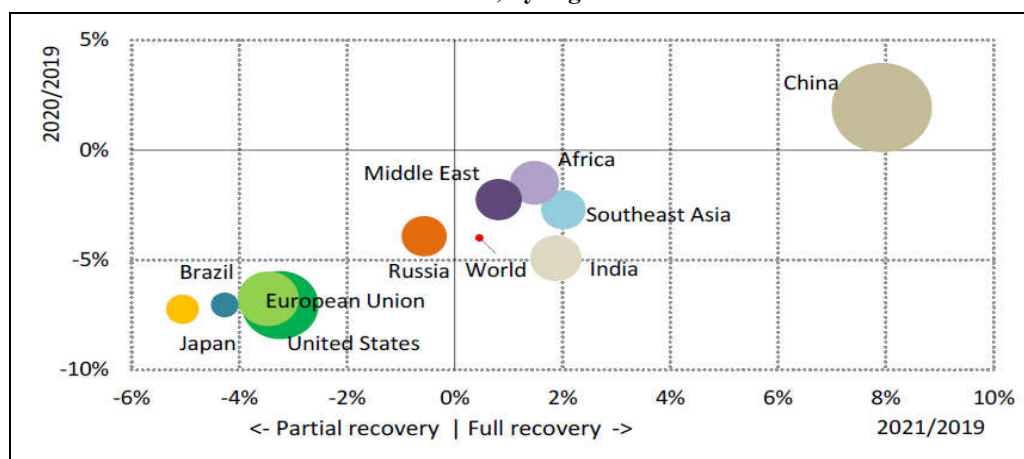

Source: IEA

3.1. The impact on oil sector and future prospects

It needs to be highlighted that the drop in energy demand during 2020 did not affect all fuels evenly. Oil of example, has suffered by far the hardest hit. As depicted on Figure 3, oil demand was down by almost 9% across the year. Indeed, world oil demand in 2020 was significantly decreased by 9.2 million b/d to average 90.5 million b/d (99.7 million b/d in 2019), recorded the largest ever decline in both absolute and relative terms. The transport sector, responsible for around 60% of total oil demand, was severely impacted by mobility restrictions. On the other hand, world oil production plummeted to 88.7 million b/d (99.1 million b/d in 2019), as OPEC and non-OPEC members proceeded on extended production adjustments as a mean to rebalance market prices in the short term (Platts 2020).

Figure 3: World oil demand and supply 2015-2021* (in million bpd)
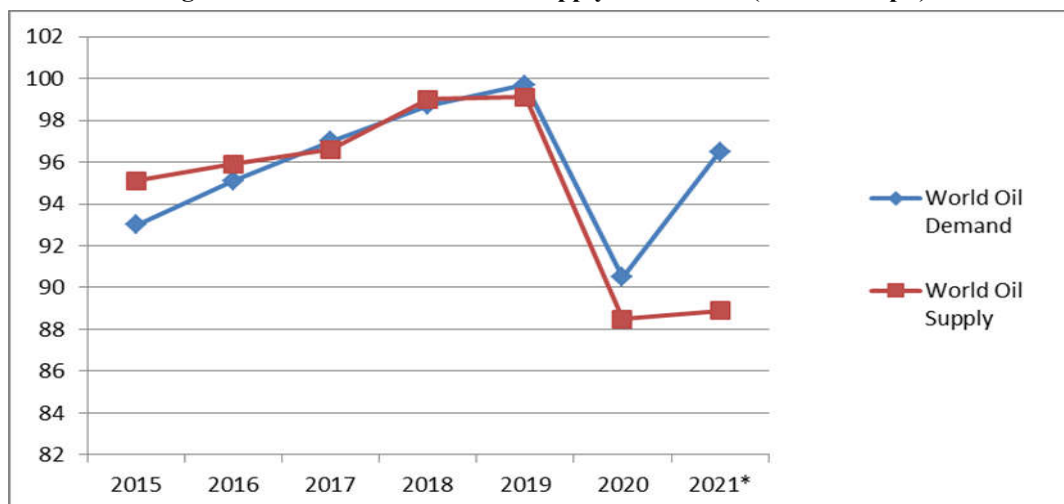
Source: OPEC

As it refers to global oil prices (Figure 4), WTI and Brent recorded historical low values, attributable to the pandemic, as the aforementioned plummet in oil demand has led to accumulative unsold cargoes.

Figure 4: Brent and WTI oil prices 2015-2021* (in $/b)
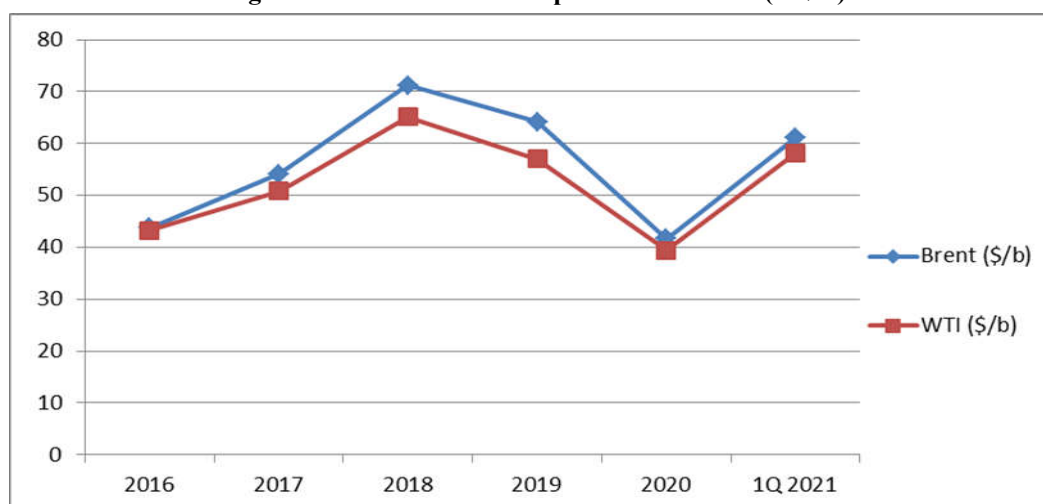
Source: OPEC

In 2021, the improving economic outlook will support a rebound in global oil demand by 6%. Indeed, world oil demand is expected to reach 96.5 million b/d while world oil production will stand at 88.9 million b/d (OPEC 2021). The 7.6 million b/d supply glut, boosts oil prices firmly above 60$/b. So far and despite the strong rebound, oil demand remains 3.1 million b/d below 2019 levels (-3%) as COVID-related restrictions on mobility continue to suppress oil demand for transport in the first half of the year.

It has to be pointed out that only in Asia and, most notably in China oil demand will achieve pre-pandemic levels. Indicatively, China is the only major economy where oil demand in 2020 was above 2019 levels and moreover, demand in 2021 is expected to grow further to almost 9% above 2019 levels. Without the increase in China's demand, global demand in 2021 would be an additional 1 million b/d (+1%) below 2019 levels. Oil demand in the United States is expected to remain around 0.8 million b/d below 2019 levels, mainly as a result of the continued impact of the pandemic-related restrictions during early 2021. Demand in the European Union remains 0.4 million b/d below 2019 levels, with continued lockdowns expected to weigh heavily on 2021 annual totals. In India, after further lockdowns in the first half of the year, rapid demand growth in the second half of the year is likely to push 2021 oil demand back on par with 2019 levels.

Contrary to the above, some analysts estimate that 2021 will be even worse, with low prices being maintained. That could consequently impose socio-economic challenges in many

energy producing countries and especially to those whose oil sector accounts for 90% of their public revenues. Finally, Joe Biden's commitment to the American transition to clean energy poses medium-term challenges for the oil sector.

3.2. The impact on gas sector and future prospects

During 2020 natural gas proved to be the most resilient fossil fuel than any other, as its consumption declined by 75 billion cbm (-2%) in 2020, as depicted in Figure 5, representing though the largest recorded drop of gas demand in absolute terms. The decline was mainly concentrated in the first half of the year driven by exceptionally mild weather and COVID-19 outbreaks. This relative resilience can be partly explained by upsized natural gas demand for electricity generation in United States, Europe and Asia (China, India and Korea).

Figure 5: World natural gas demand and supply 2018-2021* (in billion cbm)
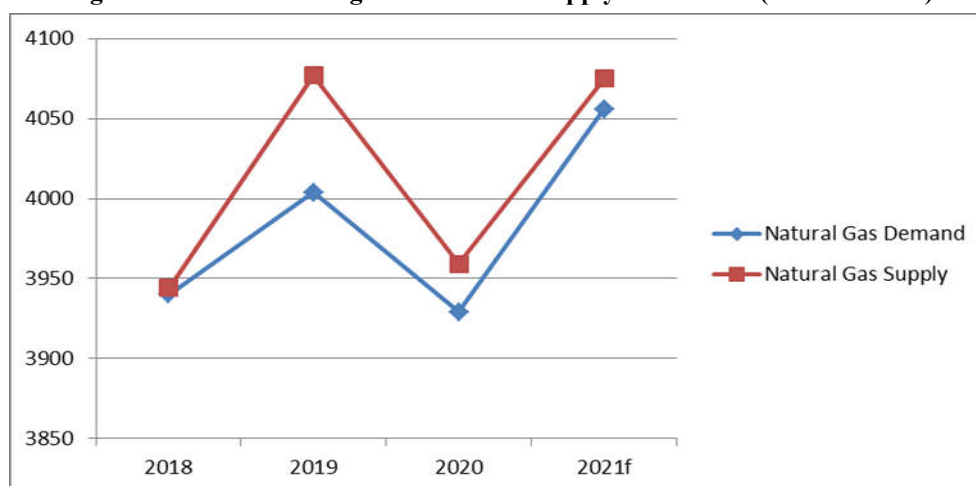
Source: IEA

On the supply side (Table 3), almost all regions were affected by production cuts. In 2020, natural gas production levels declined by 118 billion cbm (-3%). Natural gas demand in North America fell by 25 billion cbm (-2.2%) in 2020, accounting for about a third of the net decline in global gas demand. Indicatively, natural gas consumption in the United States fell by 18 billion cbm (-2%), while gas production was proportionally less affected with a decline of 1.6% or 15 billion cbm, despite the plunge in drilling activity that caused a 50% drop in the gas rig count.

Table 3. World natural gas demand and production by region and key country 2018-2021* (in billion cbm)

	Demand				Production			
	2018	2019	2020	2021f	2018	2019	2020	2021f
Africa	157	161	160	164	244	248	240	252
Asia Pacific	824	853	857	902	627	654	648	656
China	283	307	326	351	160	174	189	200
Central and South America	153	152	138	145	167	167	152	164
Eurasia	667	657	629	657	932	941	884	943
Russia	493	482	458	482	726	738	692	742
Europe	536	537	522	538	246	227	211	202
Middle East	544	547	551	569	667	677	680	707
North America	1061	1097	1072	1081	1062	1163	1144	1152
USA	854	888	870	873	868	968	953	952
World	**3940**	**4004**	**3929**	**4056**	**3944**	**4077**	**3959**	**4075**

Source: IEA

Contrary to other regions, Asia Pacific saw growing demand by 4 billion cbm in 2020 (+0.5%), while production decreased by 6 billion cbm (-1%). Japan's gas consumption declined by 4.5% in 2020 due to shrinking industrial and commercial activity. India's gas

demand shrank also by 1.4% in 2020 while domestic production also fell by 11%. On the contrary, China's natural gas consumption increased by 19 billion cbm (+6%) in 2020 while production also grew by 15 billion cbm (+9%) and reached 189 billion cbm.

On the other hand, Eurasia accounted for over 40% of the drop in global gas production in 2020. Natural gas production in Eurasia declined by 28 billion cbm (-6%), as the region's gas industry faced the double impact of lower domestic demand and exports. As it refers to Russia, natural gas production fell by 6.5% y-o-y. Furthermore, Russia's extra-regional export flows declined by over 10% y-o-y in 2020 due to lower net pipeline exports to Europe (-15%). On the other hand, pipeline deliveries to China via the Power of Siberia pipeline totaled 4.1 billion cbm in 2020, below the initially scheduled 5 billion cbm. LNG exports rose by 3%, due to Sakhalin-II and Yamal LNG ramping up export activities. Finally, domestic demand fell by 5%. European gas consumption proved to be rather resilient falling by 2.8% in 2020. European gas imports fell by 10% as, both LNG and pipeline imports were affected, falling by 3% and 12% respectively.

As it refers to regional natural gas benchmarking prices, 2020 was a roller coaster ride (Figure 6). Prices collapsed in all major gas consuming regions in the face of sharp drops in demand. Large price swings had wide seasonal spreads and high volatility reflecting unprecedented market uncertainty that prevailed through the year. Is should be highlighted though that natural gas benchmarks recorded strong gains through the third quarter of 2020, by the start of the heating season.

In 2021, natural gas demand is expected to recover by 127 billion cbm (+3.2%), the strongest anticipated recovery amongst fossil fuels. As a result, global natural gas demand in 2021 is projected to rise 1.3% above 2019 levels (Figure 7), erasing the losses of 2020 at the same time. The above is mainly driven by a combination of permanent low prices and rapid growth in economies across Asia -primarily, Middle East and Russia. It needs to be pointed out though that, the prospect of a prolonged impact of the pandemic on the global economy adds further uncertainty to the pace of short-term gas demand growth.

Figure 6: Natural gas spot prices 2020 (in $/MBtu)
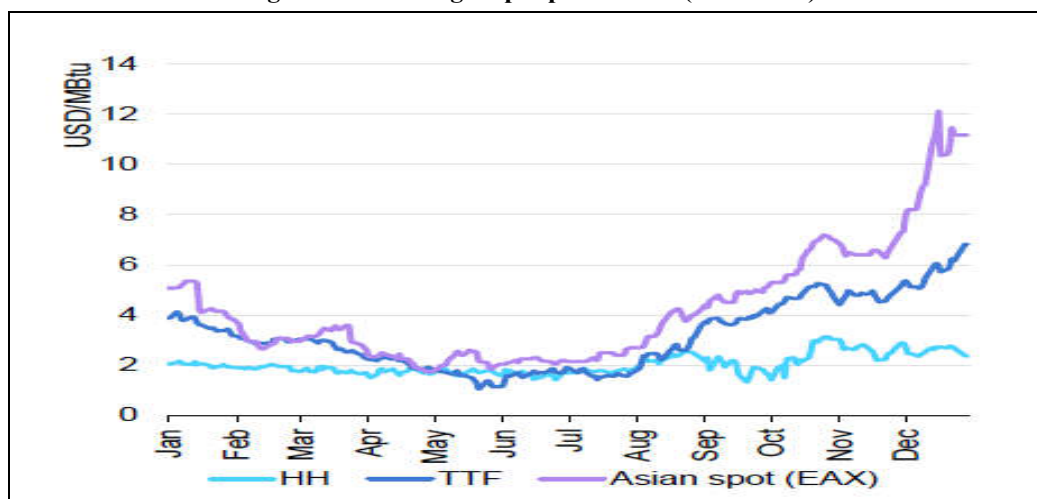
Source: IEA

Indicatively, in 2021 natural demand in the European Union is expected to rebound by 16 billion cbm (+3%), reaching 2019 levels. Moreover, Eurasian gas production is expected to continue to recover, growing by 28 billion cbm (+6%), close to 2019 levels also. This would be largely supported by the ramp-up of exports via new and traditional export corridors. Pipeline exports from Russia to Europe and from Central Asia to China are expected to increase by over 10%. Exports via the Power of Siberia pipeline are set to reach 10 billion cbm in 2021. Azeri pipeline deliveries are set to increase by over 15%, with 8 billion cbm destined for Turkey and over 5 billion cbm for other European markets. Russian LNG exports are set to increase by about 1 billion cbm. At this point, a question raises; does the EastMed pipeline have a competitive advantage against the above energy networks?

Figure 7: Evolution of global gas demand 2005 – 2021 (in billion cbm)
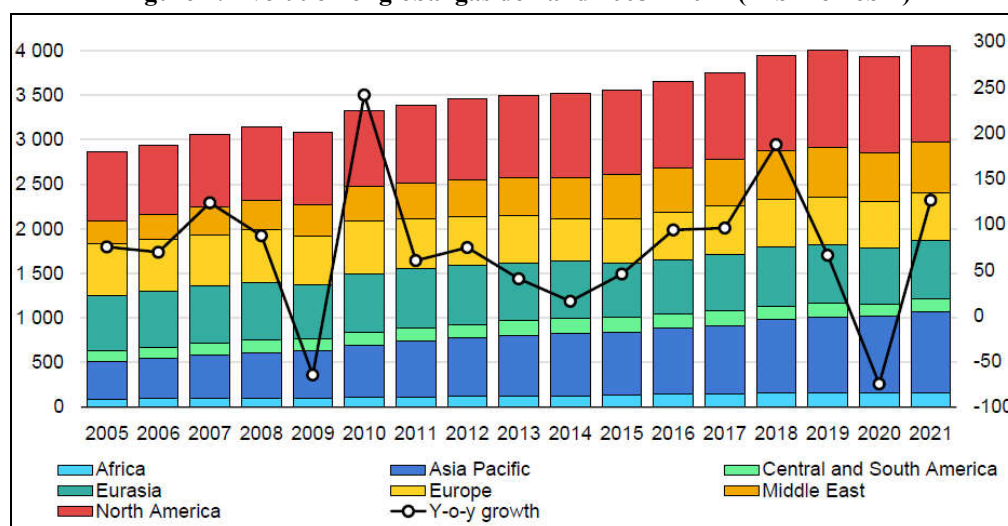
Source: IEA

North American gas demand would be almost stable in 2021, with an annual increase of 9 billion cbm (+1%). In the world's largest natural gas market, the United States, annual increase in demand is estimated to grow by 3 billion cbm, squeezed by the continued growth of renewables and rising natural gas prices.

The picture is very different across developing Asia, where demand in 2021 is expected to increase by 45 billion cbm (+5%) and 8.5% above 2019 levels, thanks to a strong rebound in economic activity and expanding gas infrastructure across the region. Asia's demand recovery is mainly driven by China, with others likely to catch up in 2021. Indicatively, China accounts for 56% of the net demand growth in Asia, followed by India with a 14% share. A group of emerging Asian economies together make up 28% of the net demand increase. In 2021 total gas demand in China is projected to increase by 25 billion cbm (+8%) or 14% higher than 2019 levels, fuelled by strong GDP growth. As it refers to India, 2021 demand is set to rebound sharply and increase by 10% on the back of a strong economic recovery, new gas connections improving infrastructure, growing domestic supply and a supportive policy environment. Finally and as it refers to Japan, despite the strong start to the year, gas demand in 2021 as a whole is projected to decrease by 3% as nuclear production restarts.

3.3. The impact on LNG sector and future prospects

Against all odds, global LNG trade grew by 1.4% in 2020, showing resilience despite the impacts of COVID-19. Global LNG trade managed to maintain a positive annual growth by 1.4%, far from the double-digit annual growth rates observed since 2016 though. Asia accounted for all the increase in LNG trade, keeping a leading 71% share of global imports. This was mainly driven by China (+12%) and India (+15%). LNG trade to regions other than Asia was declined by 4%. For example, Europe's imports were down 3% y-o-y. As it refers to United States, LNG export activity surged by 34% y-o-y, as the state was the largest source of growth on the supply side, accounting for 70% of total increase. Qatar, Australia, Russia and the United States remain the leading exporters of LNG, accounting for 66% of global supply.

The demand uncertainty related to COVID-19 and a historic oil market downturn slowed down any new investment in liquefaction capacity and gas exploration during 2020. As depicted in Figure 8, investment in new liquefaction projects stalled in 2020. After a record year for new final investment decisions (FIDs) in 2019, when nearly 100 billion cbm of new liquefaction capacity was approved, FIDs in 2020 were quite limited to only 3.4 billion cbm. The above lack of investment was due to a combination of: a) excess supply and low global gas price benchmarks, b) widespread CAPEX cuts by the major national and international oil companies, c) uncertainty about future LNG demand related to the economic impacts of the pandemic, and d) a lack of buyer appetite for long-term LNG contracts.

Furthermore, spending on gas exploration was also declined in 2020, as a structural trend, which has been fuelled by abundant unconventional resources and concerns about stranded asset risk. Exploration CAPEX in 2020 hit the lowest level in at least two decades.

**Figure 8: Investment Activity Indicators, 2015-2020**
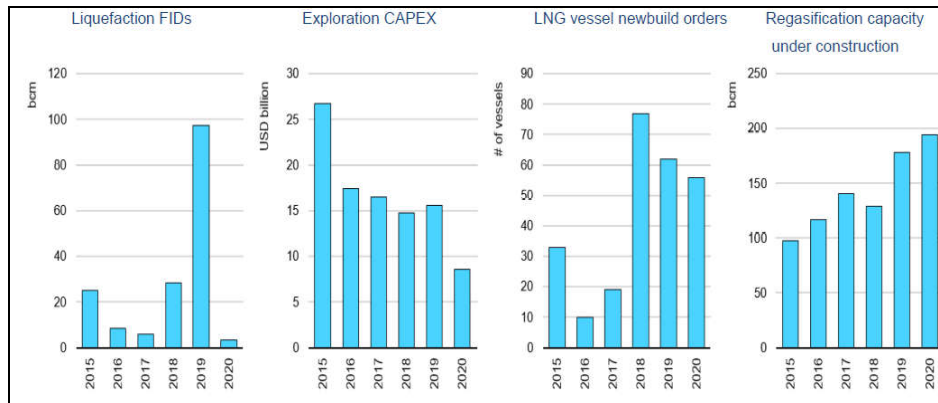
Source: IEA

On the contrary, LNG vessel orders and investment in LNG regasification projects continued at a healthy clip. Orders for LNG carrier vessels held up relatively well, as shipowners and operators ordered more than 50 new LNG carriers in 2020, about 40% more than the global five-year average, but well below the levels seen in the bumper years of 2018 (77 orders) and 2019 (69 orders). Furthermore, investment in new LNG import capacity remained relatively strong in 2020. At the end of 2020, about 194 billion cbm of regasification capacity was under construction, a 9% increase from the end of 2019. Nearly 66% of new regasification capacity under development is located in emerging markets of Asia, where new infrastructure is required to accommodate the increasing gas demand.

All things considered, in 2021 global LNG trade is projected to expand by 4%, at a slower pace relative to the 2015-2019 average annual rate of 10%, as depicted in Figure 9. LNG import growth is set to be driven solely by the Asia Pacific region, which is expected to see a 7% increase, while all other regions are poised to see declining imports. Despite the steep drop in the first quarter of 2021, European LNG imports are expected to remain relatively strong in 2021, albeit below the 2019 and 2020 levels. Furthermore, North America will remain the primary engine of LNG export growth in 2021. LNG output in the United States is set to increase by 33%, driven by the addition of new liquefaction capacity as well as by higher utilization of existing plants.

Last but not least, it should be highlighted that LNG spot charter rates have displayed strong volatility during the 2020/21 heating season as after soaring to record highs in January 2021 –between 230.000 $/d and 350.000 $/d - on high ton-mile demand, charter rates plummeted below last year's levels at the beginning of March on improving availability of shipping capacity, as depicted on Figure 10. Global LNG shipping capacity is expected to increase by 10% in 2021 while LNG exports from the United States will support ton-mile demand. LNG exports deem to provide a strong competition to pipeline networks.

Figure 9: LNG imports and exports by region 2015-2021*
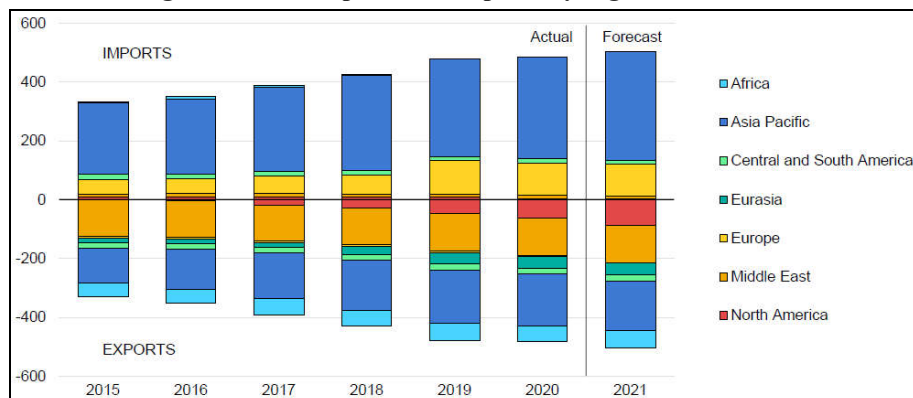
Source: IEA

Figure 10: Atlantic and Pacific spot and forward charter rates (October 2019-December 2021)
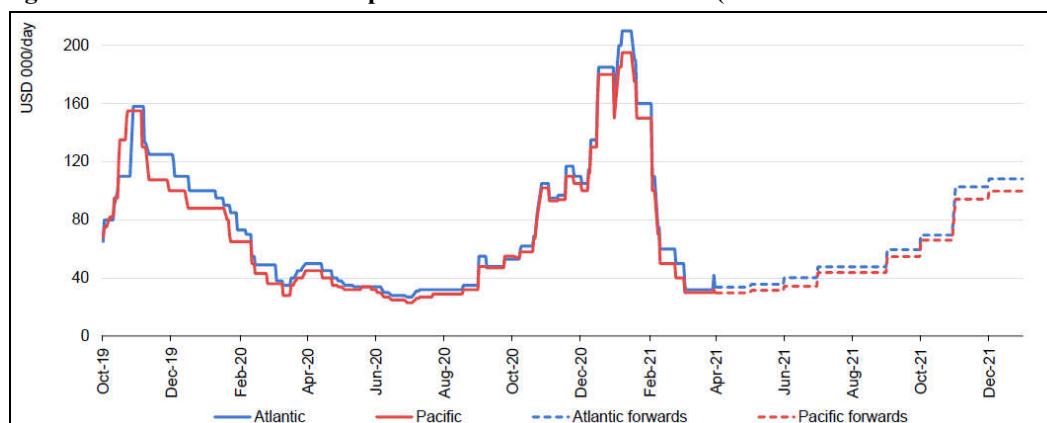

Source: IEA

3.4. The impact on major oil companies and their investment plans

Major oil companies' financial performance was devastating during 2020, due to prolonged low energy prices and an extremely weak demand. Most oil majors face high debt ratios, even those who entered the pandemic crisis with strong balance sheets. Indicatively, the United States shale hydrocarbon industry was severely affected by the collapse of oil prices between February and April 2020. During the year, the sub-index of oil companies, a part of S&P 500 index, has recorded losses of about 50%, impacting even massive companies such as Exxon Mobil and Chevron. Consequently, companies such as Exxon Mobil, Royal Dutch Shell, Total and BP were forced to minimize their cost expenditures for 2021. For example, Chevron is planning to spend only $14 billion in new investments during 2021, despite the recent acquisition of Noble Energy. These levels of investment are quite close to the minimum level of $10 billion that the company has established in order to maintain its production capacity.

Moreover, most of the aforementioned oil majors are planning to proceed in the suspension of dividend payment, for the first time in the last 40 years. As a result, the main concern for the oil majors is not whether they will survive the pandemic, but whether they will be still able to attract investors. BP and Shell have lost their market impact on European stock exchanges, while Exxon, one of the most important pillars of S&P 500, is no longer included in the top 50 American companies (Stevens 2020). As a result, in 2020 major oil companies have limited their geopolitical expansion in energy projects across the globe and focused on how to stop their financial bleeding, by eliminating any unprofitable production, future investments plans and laying off thousands of employees. Exxon is a typical example of the above; in the last 12 months the company has diminished its cost expenditures by approximately 50%, as it also plans to reduce its labor force by 15%, or 14.000 employees, by 2022.

During 2020, the US shale oil and gas production declined remarkably (Figure 11), after a decade period of important growth. Oil major executives estimate that United States shale production will never achieve the pre-pandemic levels, almost 13 million b/d. Moreover, the newly elected president of the United States, Joe Biden, has clearly stated his intentions to move the United States economy away from the oil industry by turning it to the green economy. The proposed $2 trillion plan aims to the drastic reduction of emissions and the transport sector's energy transition to electromobility.

Figure 11: United States Shale Oil Production 2018-2021

Source: BIMCO
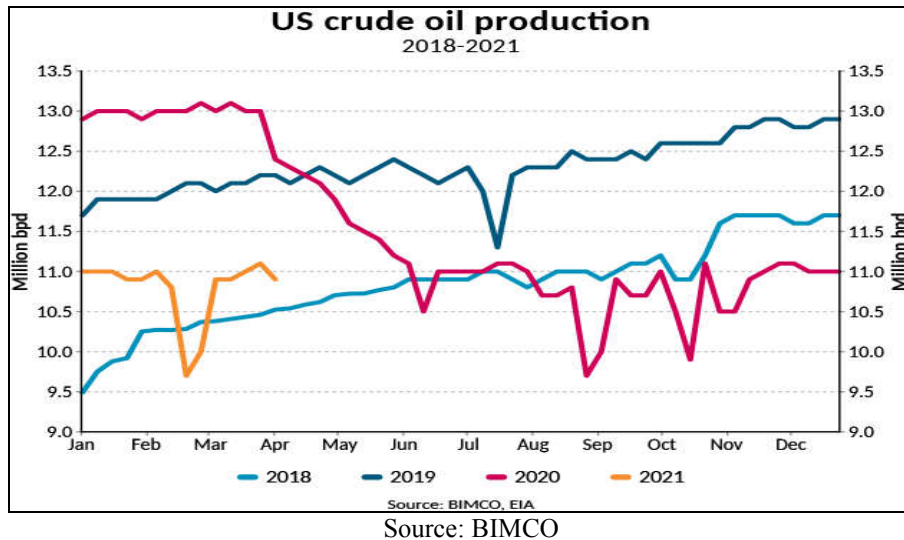
3.5. The role of renewable energy sources in the new era of energy transition

Renewables remain the success story of COVID-19 era. Demand for renewables grew by 3% in 2020, while demand for all other fuels declined. Renewables have proven largely immune to the pandemic as new capacity has come online. Overall, renewables usage grew in 2020 largely due to an increase in electricity generation from solar PV and wind. Accordingly, the share of renewables in global electricity generation jumped to 29% in 2020, up from 27% in 2019.

Renewables are on track to set new records in 2021 as demand is set to increase across key sectors such as power, heating, industry and transport. China alone is likely to account for almost half of the global increase in renewable electricity generation, followed by the United States, European Union and India. Together, they represent almost 75% of global photovoltaic and wind output. During 2021, China and the United States would represent together more than half of global wind output. While China will remain the largest PV market, expansion will continue in the United States with ongoing policy support at the federal and state level. Having experienced a significant decline in new solar PV capacity additions in 2020 as a result of COVID-related delays, India's PV market is also expected to recover rapidly in 2021.

4. EastMed Pipeline; Potentials, implications and the threat of obsolescence

There has been a lot of controversy about the potential impact of COVID-19 on energy shifts in Southeast Mediterranean (Stratakis & Pelagidis 2020) and the connection of the region's gas reserves to the European market. In order to classify the available projects and in particular EastMed pipeline, it would be very useful to estimate their implementation potentials based on the market's needs. For that reason, we should follow some basic assumptions (Filis 2021).

First of all, natural gas and LNG prices in the European market have been stabilized around $5.5-6.5/MBtu. The energy prices will be hardly modified in the years to come due to production oversupply. Secondly, the European Union's shift towards climate neutrality, aiming at eliminating carbon emissions by 2050, means that European grants and loans for energy projects, such as natural gas pipelines, will be drastically reduced. In other words, it seems that there is not enough time to implement mega energy projects, so any decisions regarding the exploitation of Southeast Mediterranean gas reserves must be addressed soon.

Moreover, natural gas production in Southeast Mediterranean is quite expensive compared to other regions. For example Egypt, the largest natural gas producer in the region has a breakeven selling price of $5/MBtu otherwise, the sector will face losses. In addition, Israel's selling price to the national electricity authority is at $4/MBtu. Given the conditions, "expensive" gas reserves may not be exploited. An expensive gas reserve is considered the one whose exploitation is unviable due to geopolitical and economic reasons.

Finally, Egypt especially after the discovery of the largest gas deposit in the Southeast Mediterranean, the Zohr gas field with a capacity of 800 billion cbm, seeks to be promoted as the only production and export energy hub in the region. In addition, Egypt's two existing gas liquefaction plants (LNG terminals) have a great advantage, offering to neighboring producers, such as Israel or Cyprus, the opportunity to make use of those facilities in order to avoid the construction cost of building new ones in their territory.

4.1. EastMed pipeline and potentials

EastMed pipeline is a very crucial project for EU's diversification of energy sources, as its completion will ensure the competitiveness of natural gas in Southeast Mediterranean region. On this basis, the European Commission has identified EastMed as a project of common interest (PCI) and funded with € 34 million the detailed studies that will allow the final investment decision (FID) to be taken by the end of 2022. After three years of construction, or 7 according to pessimistic approaches, the pipeline is expected to be operational in 2025 the earliest. EastMed will be able to initially transport between 10-20 billion cbm of natural gas annualy. According to latest information, the project will be also built with specifications for transporting hydrogen (Figure 12).

Figure 12: EastMed pipeline
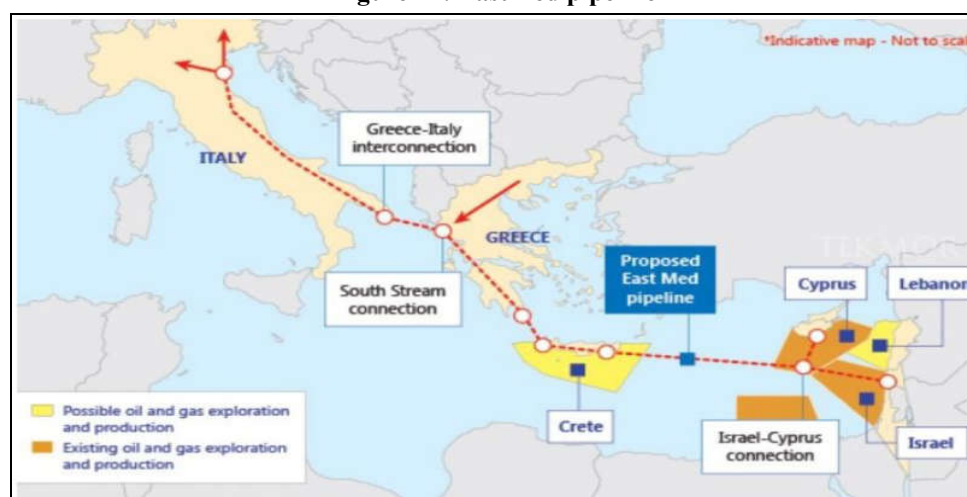
Source: IGI Poseidon

EastMed pipeline has the governmental support of Greece, Cyprus, and Israel, while there is also political commitment from Italy to sign it. Italy has yet to sign the agreement quoting environmental concerns but, recently and under new government by Draghi, there is a strong belief that Italy will sign the transnational agreement for the pipeline, since it is the destination country of Southeast Mediterranean region gas reserves. This potential development is strengthened by the completion of TAP pipeline.

It is a matter of fact that there is a lack of energy infrastructure in Southeast Europe and that situation could be exacerbated by the fact that the aforementioned energy transition process is taking less into account the support of strategic mega energy projects. It should be highlighted though, that a two-speed Europe seems to be emerging. Specifically, in North and Central Europe and in less than ten years, several crucial energy projects and gas pipelines have been completed, such as Nord Stream I and II pipelines; while on the contrary, in Southern Europe there is only TANAP-TAP pipeline with 10 billion cbm annual capacity, up to the moment.

The potential of EastMed pipeline has been under question recently, as it refers to its technical feasibility and economic viability (Stratakis & Pelagidis 2018). According to IGI Poseidon, the implementation body, EastMed pipeline is a completely realistic project, as the technical feasibility study that emerged in 2017 did not identified any obstacles in certain issues such as the depth and the length of the pipeline. It should be noted that the project is quite similar to Turk Stream pipeline in Black Sea, in terms of length and depth, which was successfully put into operation in 2019. Therefore, the technology exists and it is proven.

On the contrary and as it refers to the extraction of natural gas from the fields of Southeast Mediterranean, there have been many scenarios that lean towards the LNG exports. In that occasion, there are certain concerns on the necessity of EastMed pipeline. According to IGI Poseidon, the comparison between the two options is consistently in EastMed's favor as, referring to exports to Europe, the LNG cost chain (liquefaction, gas compression, shipping, and regasification) is more onerous than just EastMed's transport cost. On the contrary, it is true that LNG has the competitive advantage of reaching in more distant and emerging markets, such as Asia.

Another benefit of EastMed pipeline is that it could contribute to the energy transition process, as natural gas has been characterized as "the transition fuel". From an economic point of view, IGI Poseidon is developing a business model based on long-term contracts between gas producers and first-tier European buyers, which will allow the project to be financed and ensure all stakeholders' satisfaction (producers, buyers and governments).

All things considered, the final implementation of EastMed pipeline must meet three basic conditions: a) sufficient gas reserves (proven but difficult to exploit), b) economically viable solutions for the project's operation (under question) and c) available markets for exports (mainly Europe and under a supportive role).

4.2. EastMed pipeline and implications

Natural gas pipelines are long-term capital intensive projects, which even if their financing had been secured, their large invested capital would require decades to be depreciated. There has been a lot of controversy about what might hinder the completion of EastMed pipeline. The answer to the above question can be summarized in certain reasons.

The first reason has to do with the European policies about climate change that are under development, as they dictate a 55% reduction in emissions until 2030 and a zero carbon footprint by 2050. Consequently, projects of common interests such as pipelines are considered as ineligible costs, meaning that they will face limited financial support and funding. Furthermore, EastMed pipeline does not appear to have secured the necessary quantities of 10 billion cbm for annual gas export activity and as a result, it is quite difficult to gain funding by banks, energy consortia and construction companies.

Since its initial conception in 2010, the EastMed pipeline seems to have a lot in common with another mega energy project that caught the attention of international energy diplomacy for 11 years and finally was aborted as unrealistic, the Nabucco pipeline (Myrianthis 2021). Proposed in 2002, it was a project of enormous dimensions and importance, analogous to the current EastMed or Nord Stream I & II pipelines. Its implementation though, would decisively upgrade Turkey's energy and geopolitical role. Nabucco pipeline was aiming at the reduction of European Union's energy dependence from Russian gas. It would have an annual capacity of approximately 10-20 billion cbm and was politically supported by the European Union, the United States and international credit institutions such as EIB, EBRD, IFC etc. Moreover, Nabucco pipeline's construction cost was quite high, in the range of €8-10 billion and consequently, it had to address the problem of securing minimum quantities of proven natural gas deposits available for transportation.

As it refers to EastMed pipeline, the minimum quantities of proven natural gas deposits required for exports, range between 280-300 billion cbm. These quantities, with the exception of the Egyptian Zohr, are not currently available, despite the occasional optimistic statements. Moreover, the most important obstacle in EastMed's implementation could be the price of natural gas to be supplied. Supposing the production cost of natural gas in the Mediterranean is set at $4-5/MBtu as expected, the additional overall transport costs of approximately $2.8/Mbtu - $3.5/Mbtu would place EastMed in the lowest range among European gas supply options. On the contrary, Russian gas supply is more profitable even with price levels as low as $4/Mbtu, plus the transport cost of about $0.9/Mbtu in the case of NordStream I & II pipelines. The question here lies on whether there is any country that would jeopardize or undermine its economy in order to be energy independent from Russia.

EastMed pipeline faces direct competition from Nord Stream II pipeline. Once operative in 2021, it will increase European dependence on Russian natural gas. Nord Stream II pipeline is a German-Russian interests' project and costs $11 billion. Furthermore, EastMed pipeline has a limited capacity and it is unable to cover a large proportion of EU's gas needs. For example,

in 2020 EU's gas demand was 522 billion cbm and as a result the potential of 10 billion cbm, which is the pipeline's capacity, only covers 2% of demand. On the contrary, NordStream I and II pipelines will have a combined annual capacity of 110 billion cbm. The other alternative option is transfering gas to Egypt's liquefaction plants; that adds a cost of at least $3.5-4.5/MBtu.

Finally, the duration of the pipeline's construction process is estimated at 7 years. That means that beginning in 2022 after the FID announcement, the project will be completed in 2029. It seems that EastMed pipeline has the disadvantage of being a quite long-term energy project while at the same time it is being downgraded by low energy prices that prevail worldwide, the great depths it approaches and the limitations imposed to its diameter that restrict its capacity.

4.3. East Med pipeline; the threat of obsolescence by green policies

As it is already mentioned, oil demand and energy prices declined, creating losses in large energy companies. According to many analysts, any recovery in energy sector will probably be felt after 2023. Until then, there is a certain unwillingness to invest in gas and oil pipelines. Moreover, energy companies tend to diversify from hydrocarbons, for the benefit of renewable energy sources and, in the long-run, for hydrogen economy. The world energy market is turning towards cleaner and greener solutions.

As it refers to European Union, it is expected to reduce its use of natural gas by 29% for the next decade and by 90% until 2050 in order to achieve current and future climate and energy targets. As EU gas demand plummets, Southeast Mediterranean natural gas deposits will only decrease further in value. A more radical approach to the energy issues of the Southeast Mediterranean region claims that investments in oil and natural gas are obsolete as the great technological developments of 2018 have brought the energy sector in the era of renewable energy sources (Rabinovich 2021). On the contrary, oil and natural gas dynamics in the Southeast Mediterranean region emerged in the period between 2012 and 2017. As it refers to Greece and Turkey frictions over the continental shelf and the ambition to find oil and gas, this is believed to be an outdated discussion that will be definitely obsolete in a few years.

On a global level, 2021 will mark cooperation between nations in tackling climate change, as green policies are gaining ground (Bremmer & Kupchan 2021). A new, hard-to-reverse situation will emerge in the market, encouraging clean technologies, such as green hydrogen, for which, a massive investment wave on a global level is expected. Humanity puts its hopes in green hydrogen for the independence from fossil fuels and their effects on the environment and climate change. It is expected to be the fuel of the future as it has the advantage of not producing exhaust gases, contrary to conventional hydrogen produced by natural gas, emitting significant amounts of carbon dioxide during the production process. Green hydrogen is produced by electrolysis and it is much cheaper than blue or gray which are produced by the combustion of shale hydrocarbons.

Green hydrogen has a crucial role in new US president Joe Biden's climate agenda, as at the same time it is now at the forefront of governments' energy policies, absorbing funds from industries that are constantly planning new investment initiatives for its utilization and at the same time attracts investors. As it refers to Europe and under an ambitious plan to transit into an economy free of fossil fuels and emissions in the future, EU plans to invest €470 billion in hydrogen projects by 2050, which are going to have an effect on a range of highly polluting industries. European Union's green hydrogen strategy set out in July 2020 is aiming to the production of 1 million ton of green hydrogen by 2024 and 10 million tons by 2030. China, Japan, South Korea, Australia and New Zealand have already launched green hydrogen strategies ensuring their commitment to zero emissions by the middle of this century.

All things considered, the goal of decarbonization by 2050 has been set along with the strong development of renewable energy sources and new technologies such as hydrogen. Hydrogen and renewables though, are on their early stages in terms of developments and facilities, as it is assumed that by 2050 they will cover only 20%-30% of European energy needs.

5. <u>Conflicted geopolitical interests in the region; impact on EastMed pipeline</u>

Despite the fact that natural gas reserves in Southeast Mediterranean region are estimated to worth billions (Stratakis & Pelagidis 2020), they have been for long a sticking point for geopolitical shifts between the involved countries. The EastMed pipeline, has acted as a catalyst for multilateral agreements between Greece, Israel, Cyprus, Egypt, the European Union and the United States (Mazis & Sotiropoulos 2016). EastMed pipeline gave impetus to the creation of the EastMed Gas Forum, which is a significant political achievement of cooperation between Israel, Egypt, Jordan, the Palestinian Authority, the United States and the European Union. On the contrary, EastMed's route through a disputed area that Turkey claims and the aforementioned reluctance of Italy to support the project, significantly reduce its dynamics.

Turkey, on the other hand, is keenly interested in the region's hydrocarbons in order to reduce its dependence on both Russia and Iran, as well as their export prices. Moreover, it also seeks to upgrade its geopolitical impact by dominating in all the so far proposed projects in Southeast Mediterranean. The extreme aggressive policy of Turkey jeopardizes the economic viability of EastMed pipeline. It is a matter of fact that the last summer's Southeast Mediterranean crisis, promoted by Turkey, has raised great concerns among the involved countries (Greece, Cyprus and Israel) about EastMed pipeline's safety. The plan that so far gathers the greatest chances of implementation is exporting Southeast Mediterranean natural gas reserves as LNG from Egypt. Both Israel –in 2021- and Cyprus –since 2018- are seeking to reach an agreement with Egyptian authorities in order to transfer part of their production to the two Egyptian liquefaction plants of Idku and Damietta.

5.1. The new proposed pipeline between Egypt and Israel

In the early 2021 significant displacements in the Southeast Mediterranean region are being observed. In February, Egypt and Israel agreed to proceed with studies for the implementation of a new gas pipeline that would transport Israeli natural gas through offshore pipelines to the Egyptian LNG terminals at Idcu or Damietta which have been active for eight years, from where liquefied petroleum gas (LNG) exports to Europe will take place (Figure 13). According to other sources, Egypt is proposing a partial change or a redirecting of EastMed's route bypassing Cyprus (Athanasopoulos 2021).

Figure 13: Southeast Mediterranean gas reserves' connectivity to Egypt's LNG plants
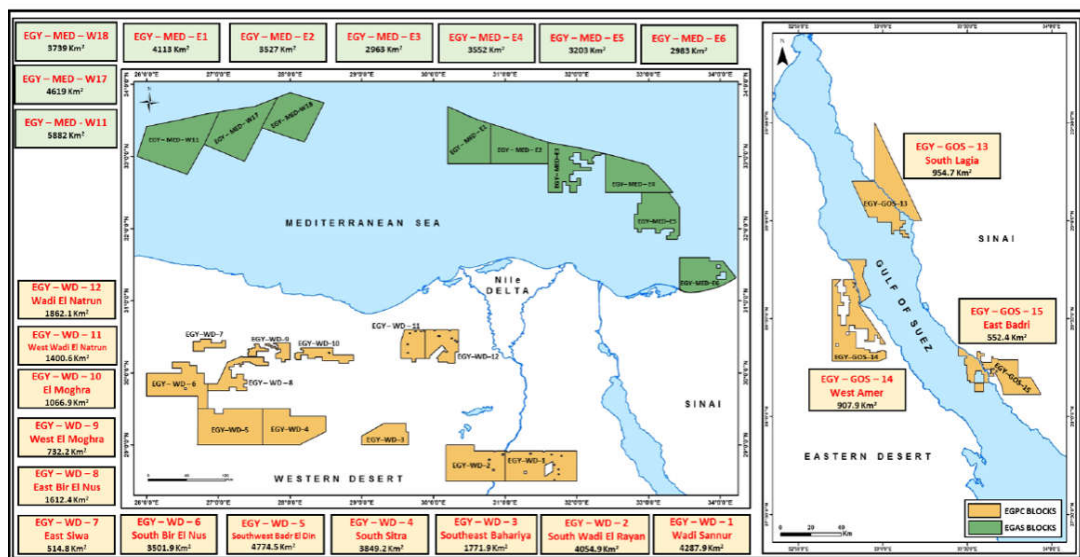

Source: EGAS

This agreement has two geopolitical dimensions, as it concerns the two countries with the largest proven and most exploitable gas fields in Eastern Mediterranean. The first dimension concerns Turkey, as Egypt and Israel decided to cooperate immediately, ignoring Turkey's demand to be the gas channel to Europe. In other words, they invalidate the basic Turkish claim about its "ideal" geographical location for exporting the natural wealth of the Eastern Mediterranean. The second dimension concerns the fate of the EastMed pipeline. Although, in theory, East Med remains on the table, the agreement between Israel and Egypt suggest that

the Cyprus political stalemate favors the activation of other gas exploitation and transmission channels.

Indeed, the main reason behind all the above actions is focused on the fact that Southeast Mediterranean's natural gas expoitation is diplomatically halted due to the unsolved Cyprus issue. The main aim of all the aforementioned backstage processes is to find a way of exploiting the region's resources and neutralizing the reaction of Turkey by bypassing Cyprus at the same time (Nedos 2021). The above development clearly jeopardizes Eastmed's financial viability, as significant quantities of natural gas are being removed. Israel's stance is maybe attributed to the will of commercial operating the proven gas reserves in the Levantine basin as Israel, may has estimated that by waiting for EastMed's completion in the future, they may be delaying their development opportunities.

On the contrary, due to the aforementioned Egyptian actions, the geopolitical situation in Southeast Mediterranean is becoming even more complicated and unstable. Besides any thoughts and plans about altering the direction of EastMed pipeline, the recent proclamation from the Egyptian natural gas company (EGAS) of three offshore regions lies in area adjacent to the boundary line of exclusive economic zone of Greece –that signed on August 2020, caused the latter's dissatisfaction (Figure 14). The area of researches is also adjacent to "Erdjiyes line", the upper limit of the Turkish continental shelf and exclusive economic zone in Eastern Mediterranean (Figure 15).

**Figure 14: Egypt's proclamations on new offshore regions in 2021**

Source: EGAS

The disputed area, called EGY-MED-W18, extends eastwards, beyond the 28th meridian, a key point for Turkish claims, following Erdjiyes line which ignores completely the rights of Kastelorizo complex and actually, divides the area between Turkey and Egypt (Mazis & Sgouros 2010). It seems that Egypt had a double agenda of promoting an indirect approach with Turkey, as the latter has made her willingness clear to proceed with Egypt in a delimitation of their maritime zones. It seems though unlikely for Egypt to jeopardize the already existing network of regional partnership, especially when the country has the leading role in energy policy and gas production of the region. For that reason, in late March 2021 and after tough political and diplomatic negotiations, Egypt readjusted the disputed block EGY-MED-18 so that it does not extend beyond the 28th meridian (Figure 16).

Figure 15: The boundary line of exclusive economic zones of Greece and Egypt
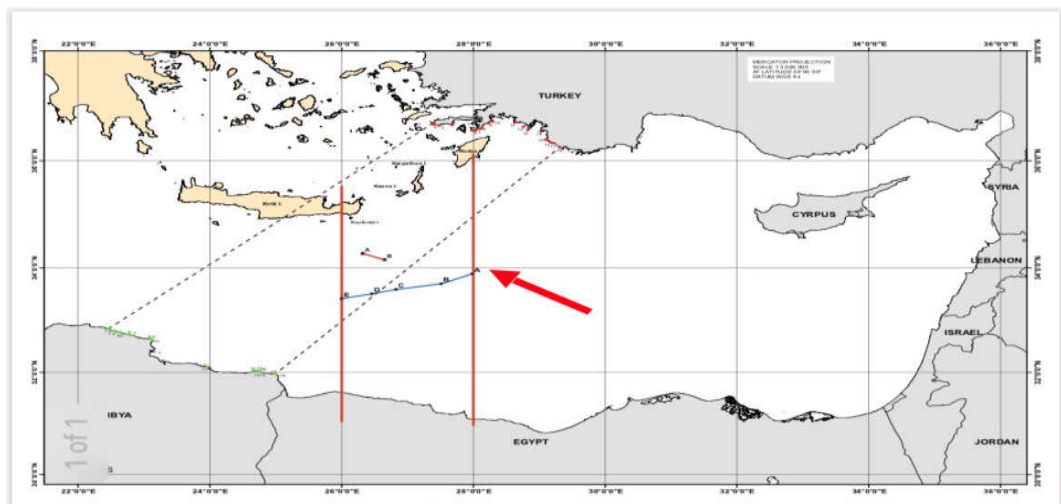
Source: EGAS

Figure 16: Egypt's proclamations on new offshore regions (new EGY-MED-18)
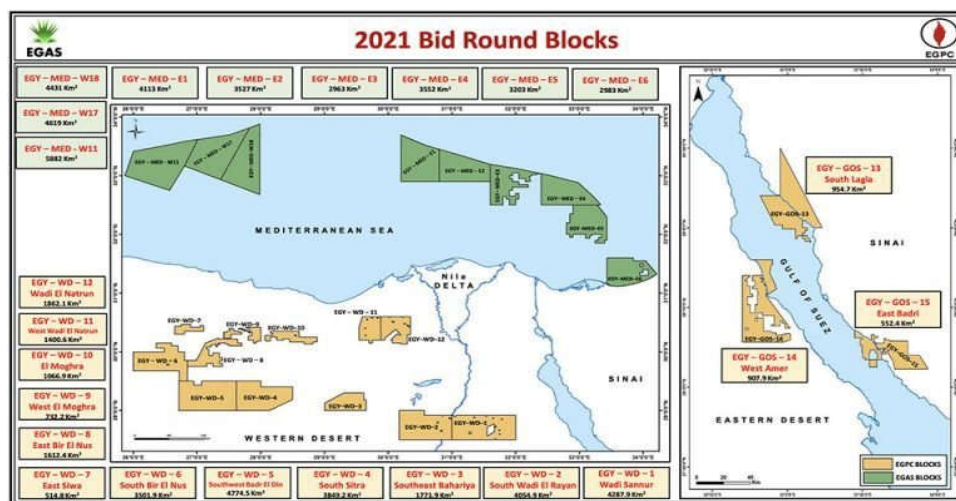
Source: EGAS

5.2. European Union's stance towards exploitation of Southeast Mediterranean gas reserves

It is a matter of fact the aforementioned proposed plan on redirecting or completely substituting EastMed pipeline mobilized discussions across European Commission, as it seems that there is common belief that the construction of the pipeline -in its current form- will not be a viable economic option (Michalopoulos 2021). Moreover, according to European Commission, the alternative option of transporting LNG must be also examined, under the wider scope of examining the cost and the benefits between them (Stratakis & Pelagidis 2019). Many analysts support that EastMed is mainly a "political project" (Drousiotis 2021) while according to others; it is considered a "pipedream" instead of a pipeline.

On a political level, the construction of EastMed pipeline would be beneficial for Greece, Israel and Cyprus, as it would send a powerful political message to Turkey. On the other hand, the solution of LNG transportation would be of high favor to Italy and ENI, in particular. According to diplomatic sources, the Italian oil major ENI exerts massive pressure to the Italian government, as it seems to prefer the exploitation of Southeast Mediterranean's gas reserves to occur via LNG exports and not by EastMed pipeline. ENI already acquires a strong fleet of LNG vessels in Leviathan gas field and such an opportunity could support the

company to fully prevail in the transportation of LNG across Mediterranean Sea. Of course, it should be pointed out that a development like this would have an impact on the interests of Greece in the region, which of course has a more powerful LNG fleet with global employment.

On the contrary though, the political aspect of EastMed pipeline does not leave Italy indifferent, as up to the moment, there are already two pipelines from Algeria and Tunisia that end up in Sicily and Sardinia, as well as the TAP pipeline. With EastMed pipeline, Italy could become an energy hub in the Mediterranean Sea, so as to counterbalance the energy leading role of Germany in Central Europe. It is a matter of fact that Germany ignored the rest EU member states and bilaterally negotiated Nord Stream II pipeline with Russia and as a result, managed to double Russian natural gas imports and became the sole energy hub in Central Europe.

Moreover, in view of the European Green Deal, new challenges are emerging and European Union has to address certain matters in order to become the world leader in the global energy and digital transition (Maniatis 2021).

5.3. United States' stance towards exploitation of Southeast Mediterranean gas reserves

The Biden administration promotes climate change issues on top of its priorities, including energy matter. The United States energy policy in the Southeast Mediterranean region is going to promote the development of a regional energy market (Fannon 2021). However, United States keep equal distances from the geopolitically delecate issue of the appropriate route that proven deposits of the Southeastern Mediterranean should follow on their exit to major consumption centers and the promotion of Greek interest East Med pipeline. According to United States Department of Energy officials, the promotion of a Mediterranean gas market could include the potential East Med pipeline along with other alternatives. The aim is to promote a free, fair and open market where the participating energy companies will be in their best position to deliver their product to buyers. The recent Chevron's decision to acquire Israel's Noble in 2020, is a sign of confidence in the geological prospects and political stability of the region.

United States government supports positive energy developments in the Eastern Mediterranean, as American companies have played an important role in the discovery of gas fields and have managed to increase their investment in the region, despite the pandemic that shrank the oil and gas sectors by 30%. According to the United States approach, energy could serve as a tool for other foreign policy issues and encourage the development of regional energy markets, especially in the Southeast Mediterranean. Energy cooperation can affect other sectors such as enhancing political stability and maintaining a degree of continuity in their policy.

As it refers to the impending completion of Nord Stream 2 pipeline, the United States has pledged to impose sanctions on companies involved in its implementation and furthermore, many actions have been taken to postpone its operation. It has to be pointed out, that both political parties are opposed to the final implementation of the pipeline.

6. Conclusions

It is a matter of fact that the rising geopolitical tensions in Southeast Mediterranean region as well as the recent implementing policies towards the energy transition era shape the possibility of abandoning the EastMed pipeline as realistic. In such a case, countries such as Greece and Cyprus, that do not benefit from the aforementioned development must act accordingly and seek for alternative options. The best case scenario lies in a partnership with Egypt and Israel both on a transnational and a corporate level. On the contrary belief, EastMed pipeline's route cannot be changed despite the indirect and vague challenges that the project had faced. The possibility of an additional and not alternative line to Egypt confirms the growing interest for EastMed pipeline, as on the contrary the idea of the pipeline's heading to Egypt has no basis. In the geopolitical level, there are increasing indications that no common ground can be with Turkey. As a result, the countries of East Mediterranean Gas Forum must capitalize on strengthening the relations between them and the United States in

order to find the best exploitation option. That, combined with a series of geopolitical and technological developments creates the appropriate conditions for Southeast Mediterranean countries' geostrategic and geoeconomic upgrade.

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<u>Announcements, Conferences, News</u>

ASSA 2022 Annual Meeting
January 2022 | Boston/ Massachusetts (participation details to be determined)

Event Overview[1]

The **American Economic Association** (AEA), which was established in 1885, is a non-profit, non-partisan, scholarly association dedicated to the discussion and publication of economics research. The Association currently **counts over 20,000 members** from academe, business, government, and consulting groups, within diverse disciplines from multi-cultural backgrounds, dedicated to economics research and teaching, and supports established and prospective economists with a set of career-enhancing programs and services. The AEA, in conjunction with 64 associations in related disciplines known as the **Allied Social Science Associations** (ASSA), holds a three-day meeting each January to present papers on general economics topics. Over 13,000 of the best minds in economics are assembled to network and celebrate new achievements in economic research. The meeting is generally organized as follows:

• **Program:** Offers in-depth coverage of economics topics across many disciplines via hundreds of speakers and panels.

• **Job Interviews:** The concurrent economics job fair brings together thousands of job-seekers and recruiting companies in pre-registered interview sessions.

• **Special Events**: The Presidential Address, award presentations, lectures, and many networking opportunities are also part of the experience.

• **Proceedings:** The American Economic Association publishes a Papers and Proceedings edition, in May, highlighting selected papers from the meeting, and a limited number of sessions are featured on webcasts.

• **Exhibit Hall:** Meet representatives offering specialized products and services serving economists and those in related disciplines

ASSA is the premiere event to expose scientific and research work with colleagues and hear about the latest research emerging in the field. Economists from around the world take advantage of this unique opportunity to share, collaborate, and learn... all in one place. The ASSA 2021 meeting was held virtually in January 3-5, 2021. The **upcoming meeting is scheduled to be held in Boston, Massachusetts, at January 2022**. Sessions proposals and papers were submitted electronically (submissions are not any more available), via the American Economic Association website, between March 1 and April 15, 2021, where the condition to submit is at least one author of each paper must be an AEA member. Information about the upcoming 2022 annual meeting is announced on the AEA website (https://www.aeaweb.org) as it becomes available for presenters, attendees, and exhibitors.

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1 Event overview edited by Dimitrios Tsiotas, RSIJ

19th EURegionsWeek 2021 of Regions and Cities
11 -14 October 2021 | Online participation

Event Overview[2]

The **Regional Studies Association European Foundation** (RSA Europe) is partnering in the #EURegionsWeek, **11 -14 October 2021**, the European Week of Regions and Cities, which is the biggest annual Brussels-based event dedicated to regional policy. This event serves as a platform for discussing and showcasing the development of the EU cohesion policy and contributing decision-makers being more aware of the importance of regions and cities in the EU.

The University Sessions are organized by the European Commission, Directorate-General for Regional and Urban Policy (DG REGIO) and the European Committee of the Regions (CoR) advised by the RSA Europe, the cooperation of the European Regional Science Association (ERSA) and the Association of European Schools of Planning (AESOP).

The academic societies (led by RSA Europe) will host around 10 Sessions in-person or virtual (the format will be confirmed) showcasing the best of new research to the largely policy-based audience at the week.

The RSA Europe now invites proposals for these sessions and submission of proposals that may relate to the following overarching themes which constitute the focus of the 19th edition:
- **Green Transition:** for a sustainable and green recovery
- **Cohesion:** from emergency to resilience
- **Digital Transion:** for people
- **Citizens' engagement:** for an inclusive, participative and fair recovery

Proposals should to be submitted online at the link:
https://rsaeurope.org/event/euregionsweek-2021/
More info can be found at the link:
https://europa.eu/regions-and-cities/home_en

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2 Event overview edited by Dimitrios Tsiotas, RSIJ

Academic Profiles

Dr. **Christos T. Papadas**, Ph.D, is a graduate of the Department of Economic Sciences of the Athens University of Economic and Business (AUEB), and he holds a postgraduate (M.Sc.) and a doctoral diploma (Ph.D.) in the Rural and Applied Economy, from the Department of Applied Economy of the University of Minnesota (USA).

He has worked as a researcher in the University of Minnesota and has taught both in undergraduate and postgraduate courses in the Queen's University of Northern Ireland, in the Department of Rural Economy, as a tenure track Professor.

His research interests focus on the areas of economics and growth, rural growth, input-output analysis, and on the application of quantitative methods measuring the effect of economic policies to the rural growth, economic convergence, and income distribution. The research of Prof. Christos Papadas has been published in international scientific magazines and has been presented in scientific conferences.

Currently, Prof. Christos Papadas teaches various courses, as the undergraduate *Rural Products Prices Analysis, Theory and Policy of Rural Development, Mathematics, and the postgraduate Applied Microeconomics in the Rural Economy and Economics of Rural Development.*

The administrative contribution of Prof. Christos Papadas is also considerable, since he is currently the Chairman of the provisional Assembly of the newly established Department of Regional and Economic Development (R.E.D), of the Agricultural University of Athens, which started to operate in the city of Amfissa (Phocis/Fokida region), in the academic year 2019-2020. His contribution was determinant to the constitution and functionality of this new department, which is currently offering competitive undergraduate courses consisting of a high level program coordinated in economics and integrating the conceptualization of spatial and developmental approaches. Although is operationally attached to an Agricultural University, this newly established Department grants full professional qualifications of economist and accountant, thus offering the background for the development of an integrated culture between the economic sciences and the geographical and spatial (and more broadly the engineering) sciences, in the context of the multidisciplinary demand raised by the complexity of modern scientific research and life.

Academic Profile by:
Dimitrios TSIOTAS, Ph.D., RSI J

Dr. **Garyfallos Arabatzis**, Ph.D., is a Professor since 2018 at the Department of Forestry and Management of the Environment and Natural Resources of Democritus University of Thrace.

He teaches, among others, in many academic undergraduate and postgraduate courses, such as Investments and Forest Resources Development, Green Entrepreneurship and Innovation, Regional Development, Forest Valuation and Accounting, Land Use Planning, Financial Management, etc.

The published work of Prof. Garyfallos Arabatzis suggests an excellent example of multidisciplinary research, ranging from Forest, Rural, and Regional Development, Forest Economics, Valuation, Accounting, Regional Policy, Socio-Economics of Natural Resources and Energy, Operational Research, Green Finance and Development, and Investment Appraisal.

In particular, Prof. Garyfallos Arabatzis has already published over 230 articles in international and national (Greek) journals and conference proceedings, among which 110 articles are published in international journals (mainly in top-tier journals) such as *Forest Policy and Economics*, *Energy Policy*, *Renewable and Sustainable Energy Reviews*, *Business Strategy and the Environment*, *Journal of Informetrics*, *Renewable Energy, Journal of Environmental Management*, *Annals of Operations Research*, *Computers and Operations Research*. His work enjoys significant recognition from the scientific community and has been cited more than 2.600 times according to the Google Scholar database (h-index=26) and more than 1.570 times according to Scopus database (h-index=23). Also, he has coedited the book *Natural Resources, Environment, and Development*, which is a suggested textbook by many the Greek academia and is taught in several Universities.

Prof. Garyfallos Arabatzis has served as a Reviewer in more than 60 international journals, such as Land Use Policy, Energy Policy, Renewable and Sustainable Energy Reviews, Energy Economics, Environmental Monitoring and Assessment, Journal of Environmental Management. He was a senior researcher in 22 projects and a coordinator in 2 projects and he is a Member of the Editorial Board of the journal Current Trends in Forest Research.

Academic Profile by:
Dimitrios TSIOTAS, Ph.D., RSI J

Book Reviews

The American Economic Review, Vol.111, No.3, March 2021

The American Economic Review (AER) is the oldest economics journal of the American Economic Association (AEA) that was established in 1911, just 26 years after the AEA's constitution. The journal launches issues on a monthly basis and publishes selected papers of general interest in the field of economic sciences. The March 2021 issue of AER includes eight (8) research papers, as follows:

• Rank Uncertainty in Organizations, by Marina HALAC, Elliot LIPNOWSKI, and Daniel RAPPOPORT. This paper studies the principal's optimal incentive scheme that implements work as a unique equilibrium and characterizes how agents' ranking and compensation vary with asymmetric effort costs.

• What Motivates Paternalism? An Experimental Study, by Sandro AMBUEHL, B. Douglas BERNHEIM and Axel OCKENFELS. This paper experimentally examines the context of people intervening in others' choices, and particularly when, why, and how people intervene in other people's choices.

• Social Media, News Consumption, and Polarization: Evidence from a Field Experiment, by Ro'ee LEVY. This paper estimates the effects of social media news exposure by conducting a large field experiment randomly offering participants subscriptions to conservative or liberal news outlets on Facebook, where the results suggest that social media algorithms may limit exposure to counter-attitudinal news and thus increase polarization.

• Knowledge Spillovers and Corporate Investment in Scientific Research, by Ashish ARORA, Sharon BELENZON, and Lia SHEER. This paper studies how corporate investment in research is linked to its use in the firm's inventions, and to spillovers to rivals and reveals that private returns to corporate research depend on the balance between two opposing forces.

• Job Displacement Insurance and (the Lack of) Consumption-Smoothing, by Frangois GERARD and Joana NARITOMI. This paper studies the spending profile of workers who experience both a positive transitory income shock (lump-sum severance pay) and a negative permanent income shock (layoff), showing that workers increase spending at layoff percent despite experiencing long-term loss.

• The Efficiency of Race-Neutral Alternatives to Race-Based Affirmative Action: Evidence from Chicago's Exam Schools, by Glenn ELLISON and Parag A. PATHAK. This paper explores whether Chicago Public Schools (CPS) plans are effective substitutes for racial quotas, now employing a race-neutral, place-based affirmative action system at its selective exam high schools.

• The Abolition of Immigration Restrictions and the Performance of Firms and Workers: Evidence from Switzerland, by Andreas BEERLI, Jan RUFFNER, Michael SIEGENTHALER, and Giovanni PERI. This paper studies a reform that granted European cross-border workers free access to the Swiss labor market and had a stronger effect on regions close to the border, revealing effects mainly driven by firms that reported skill shortages before the reform.

• The Financial Transmission of Housing Booms: Evidence from Spain, by Alberto MARTIN, Enrique MORAL-BENITO, and Tom SCHMITZ. This paper examines the context of the Spanish housing boom, where a quantitative model disciplined by cross-sectional estimates indicates that the crowding-out effect was substantial but temporary, and had been fully absorbed by the end of the boom.

Full-text access of the published papers is available through an institutional subscription or using AEA member username and password credentials.

The link to the AER issues is: https://aeaweb.org/journals/aer.

Journal Review by Dimitrios TSIOTAS, Ph.D., RSI J

GUIDELINES

**for the Writers & a format model for the articles
submitted to be reviewed & published in the journal**

Guidelines for the Writers & a format model for the <u>articles submitted to be reviewed & published in the journal</u>

The Title of the paper must be centered, and the font must be Times New Roman, size 12, in Uppercase, in Bold

For the writers' personal information use the Times New Roman font, size 11, in bold, and centered. Use lowercase for the first name and uppercase for the last name. The line below the name includes the professional title and workplace; use the Times New Roman font, size 10, centered. In the third line write only the <u>contact</u> <u>e-mail address</u> in Times New Roman 10, centered.

Name LAST NAME
Professional Title, Workplace
E-mail Address

Name LAST NAME
Professional Title, Workplace
E-mail Address

Abstract

The abstract consists of <u>a single paragraph, no longer than 250 words</u>. The font must be Times New Roman, size 11. The text must be justified. The title "Abstract" must be aligned left, in Times New Roman, size 11, in bold. A space of one line must be left between the title and the text of the abstract. The abstract must contain sufficient information, be factual, and include the basic data of the paper.

Keywords: Use 3 to 5 keywords, <u>separated by commas</u>

JEL classification: We kindly request that you classify your paper according to the JEL system, which is used to classify articles, dissertations, books, book reviews, and a variety of other applications. The use of the JEL classification is necessary so that your paper be properly indexed in databases such as EconLit. Select the codes that represent your article and <u>separate them by commas</u>. You can find information on the JEL system here: https://www.aeaweb.org/jel/guide/jel.php

1. <u>Introduction</u>

All articles must begin with an introduction, a section which demarcates the theoretical background and the goals of the paper.

The present document provides the necessary information and formatting guidelines for you to write your article. We recommend that you copy this file to your computer and insert your own text in it, keeping the format that has already been set. All the different parts of the article (title, main text, headers, titles, etc.) have already been set, as in the present document-model. The main text must be written in regular Times New Roman font, size 11, justified, with a 0.5 cm indent for the first line of each paragraph.

We recommend that you save this document to your computer as a Word document model. Therefore, it will be easy for you to have your article in the correct format and ready to be submitted. **The only form in which the file will be accepted is MS Word 2003**. If you have a later version of Microsoft Office / Word, you can edit it as follows:

- Once you have finished formatting your text, create a pdf file, and then save your file as a Word "97-2003" (.doc) file.

- Compare the two files – the pdf one and the Word "97-2003" (.doc) one.

- If you do not note any significant differences between the two, then – and only then – you can submit your article to us, **sending both the pdf and the Word "97-2003" (.doc) files** to our e-mail address.

If you use a word processor other than Microsoft Word, we recommend that you follow the same procedure as above, creating a pdf file and using the appropriate add-on in order to save your document in MS Word "97-2003" (.doc) form. Once you compare the two files (and find no significant differences), send us both.

2. <u>General Guidelines on Paper Formatting</u>

2.1. Body

The body of the text consists of different sections which describe the content of the article (for example: Method, Findings, Analysis, Discussion, etc.). You can use <u>up to three levels of sections – sub-sections</u>. For the Body of the text, use the default format style in Word, selecting the Times New Roman font, size 11, justified, with a 0.5 cm indent for the first line of each paragraph (this is further detailed in the section "Paragraphs").

2.2. References

The references included in the paper must be cited at the end of the text. All references used in the body of the paper must be listed alphabetically (this is further detailed in the section "References").

2.3. Appendices

The section "Appendices" follows the section "References".

3. <u>Page formatting</u>

3.1. Page size

The page size must be A4 (21 x 29,7 cm), and its orientation must be "portrait". This stands for all the pages of the paper. "Landscape" orientation is inadmissible.

3.2. Margins

Top margin: 2,54cm
Bottom margin: 1,5cm
Left and right margins: 3,17cm
Gutter margin: 0cm

3.3. Headers and Footers

Go to "Format" → "Page", and select a 1,25cm margin for the header and a 1,25cm margin for the footer. Do not write inside the headers and footers, and do not insert page numbers.

3.4. Footnotes

<u>The use of footnotes or endnotes is expressly prohibited</u>. In case further explanation is deemed necessary, you must integrate it in the body of the paper.

3.5. Abbreviations and Acronyms

Abbreviations and acronyms must be defined in the abstract, as well as the first time each one is used in the body of the text.

3.6. Section headers

We recommend that you use up to three sections – sub-sections. Select a simple numbering for the sections – sub-sections according to the present model.

3.7. First level header format

For the headers of the main sections use the Times New Roman font, size 11, in bold and underlined, and leave a size 12 spacing before the paragraph and a size 6 spacing after the paragraph. The header must be aligned left. Use a capital letter only for the first letter of the header.

3.8. Second level header format

For second level headers, follow this model. Use the Times New Roman font, size 11, in bold, and leave a size 12 spacing before the paragraph and a size 3 spacing after the paragraph. Select a 0.5 cm indent. The header must be aligned left. Use a capital letter only for the first letter of the header.

3.8.1. Third level header

For third level headers, follow this model. Use the Times New Roman font, size 11, in bold and italics, and leave a size 6 spacing before the paragraph and a size 0 spacing after the paragraph. The header must be aligned left, with a left indent of 1 cm. Use a capital letter only for the first letter of the header.

4. Paragraphs

In every paragraph, use the Times New Roman font, size 11, with single line spacing. We recommend you modify the default (normal) format style in Word and use that in your text. For all paragraphs, the spacings before and after the paragraph must be size 0, and the line spacing single. Use a 0,5cm indent only for the first line of each paragraph. Leave no spacings nor lines between paragraphs.

4.1. Lists

In case you need to present data in the form of a list, use the following format:

- Bullet indent: 1,14cm
- Text:
    - Following tab at: 1,5 cm
    - Indent at: 1,5cm

Use the same format (the above values) if you use numbering for your list.

1. Example of numbered list 1
2. Example of numbered list 1

5. Figures, images, and tables

5.1. Figures and images

Insert your figures and images directly after the part where they are mentioned in the body of text. They must be centered, numbered, and have a short descriptive title.

Figures put together "as they are", using Office tools, are absolutely inadmissible. The figures used must have been exclusively inserted as images in Word, in gif, jpg, or png form (with an analysis of at least 200dpi), and in line with the text. The width of an image must not exceed 14,5cm so that it does not exceed the margins set above.

The images, figures, and tables must be inserted "as they are" in the text, in line with it. **Figures and images which have been inserted in a text box are absolutely inadmissible.**

5.1.1. Reference inside the text

Avoid phrases such as "the table above" or the "figure below" when citing figures and images. Use instead "in Table 1", "in Figure 2", etc.

5.1.2. Examples

A model of how to format figures/images follows. For the title, use the Times New Roman font, size 10, in bold. Write the title above the figure, and set a size 6 spacing before the title and a size 0 spacing after it. The line spacing of the title must be 1.5 line. Both the image and its title must be centered.

Image 1: Title
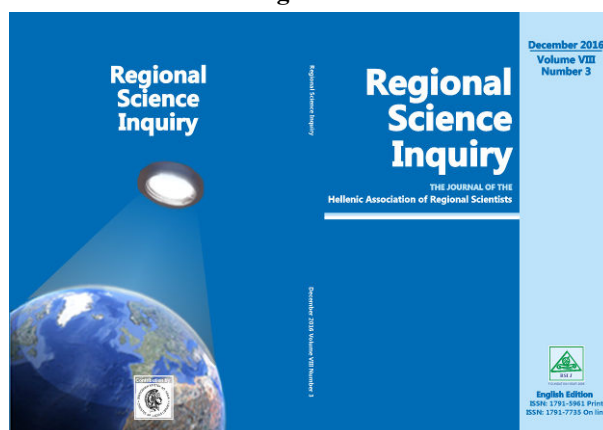
Source: cite the source

Directly below the figure you must cite the source from which you took the image, or any note regarding the figure, written in Times New Roman, size 10. Write it below the figure, leaving a size 0 spacing before and after it, use a line spacing of 1.5 line, and make it centered.

5.2. Tables

For the title, use the Times New Roman font, size 10, in bold. Write the title above the table, and set a size 6 spacing before the title and a size 0 spacing after it. The line spacing of the title must be 1.5 line. Both the table and its title must be centered. The width of the table must not exceed 14,5cm so that it does not exceed the page margins set.

Table 1. Example of how a table must be formatted

Age	Frequency	Percentage %
Under 40	44	32.1
40 - 49	68	49.6
Over 50	25	18.2
Total	**137**	**100.0**

Source: cite the source

If the table needs to continue on the next page, select in the "Table properties" that the first line be repeated as a header in every page, as in the above example of Table 1. **Tables (or figures or images) which are included in pages with a "Landscape" orientation are absolutely inadmissible.**

Every table must have horizontal lines 1 pt. wide at the top and bottom, as shown in the example. The use of vertical lines and color fill at the background of the cells is strictly prohibited.

Directly below the table you must cite the source or any note regarding the table, written in Times New Roman, size 10. Write it below the table, leaving a size 0 spacing before and a size 6 spacing after it, and make it centered.

6. Mathematical formulas

There is a variety of tools in order to insert and process mathematical formulas, such as the "Mathematics", found in the most recent editions of Word, "Math Type", "Fast Math Formula

Editor", "MathCast Equation Editor", "Math Editor". Since it is impossible for us to provide you with compatibility with all these tools in all their editions, **we can only admit your paper if it contains mathematical formulas solely in the form of images.**

Keep a continuous numbering for the mathematical formulas and center them in the page, as shown in the following example:

$$y = ax^2 + bx + c$$

(1)

The same stands for formulas or particular mathematical symbols you may have integrated in your text. For instance, if you want to use the term ax^2 in your text, you must insert it as an imaged, in line with the text. The images containing the mathematical formulas must be legible (at least 300dpi).

In the exceptional case of a text which may contain a great number of mathematical formulas, the writer may send it to us in <u>TeX form</u> if they so wish.

7. <u>References</u>

We recommend that you use the Chicago Manual of Style Author-Date system, as it is recommended by the AEA (American Economic Association) for the journals included in the EconLit database, and it is the dominant style of bibliography in the field of Economics. For more information you can go to the following links:

- https://www.aeaweb.org/journals/policies/sample-references

- http://www.chicagomanualofstyle.org/tools_citationguide.html

- http://libguides.williams.edu/citing/chicago-author-date#s-lg-box-12037253

7.1. Online references (internet citations)

Check your links again before sending your file, to confirm that they are active.

Avoid long internet links. Where possible, also cite the title of the website operator-owner. Return the font color to black, and remove the hyperlink. Links such as the following are impractical and distasteful, therefore should be avoided.

Example of an inadmissible hyperlink

https://el.wikipedia.org/wiki/%CE%9F%CE%B9%CE%BA%CE%BF%CE%BD%CE%BF%CE%BC%CE%B9%CE%BA%CE%AC

7.2. References Formatting

For your list of references, use the Times New Roman font, size 10, with single line spacing. The paragraph format must include a size 0 spacing before the paragraph and a size 0 spacing after it, aligned left. Use a 0,5 cm indent only for the first line of each paragraph. Leave no spacings or lines between paragraphs.

7.3. Example of how References must be formatted

Bureau of Labor Statistics. 2000–2010. "Current Employment Statistics: Colorado, Total Nonfarm, Seasonally adjusted - SMS08000000000000001." United States Department of Labor. http://data.bls.gov/cgi- bin/surveymost?sm+08 (accessed February 9, 2011).
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Zitzewitz, Eric. 2006. "How Widespread Was Late Trading in Mutual Funds?" http://facultygsb.stanford.edu/zitzewitz.