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Миссия журнала «R-Economy» – обеспечить публикацию исследований в области региональной экономики. Мы считаем сотрудничество с экономистами из стран БРИКС нашим главным приоритетом. «R» в названии журнала ссылается на три его базовых направления – Region (региональное развитие), Regulation (сравнительное изучение региональной политики) и Reconfiguration (пространственные социально-экономические и политические преобразования).

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Журнал включен в перечень рецензируемых научных изданий, в которых должны быть опубликованы основные научные результаты диссертаций на соискание ученой степени кандидата наук, на соискание ученой степени доктора наук (научные специальности 08.00.05 Экономика и управление народным хозяйством и 08.00.14 Мировая экономика).

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Theoretical approaches to identifying creative industries

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ABSTRACT
Relevance. The relevance of the study is determined by the growing importance of creative industries in the global economy, which necessitates the formation of common approaches to identifying and defining creative industries to make effective management decisions at the state level. The lack of a unified approach to defining the conceptual and methodological apparatus necessitates additional research on this topic.
Purpose of the study. The purpose of this study is to conduct a comparative analysis of approaches to identifying creative industries that have developed in the international and domestic academic community.
Data and methods. The study is based on the Scoping review method, which consists of a full analysis of the existing literature in the context of key concepts of a given area of research. The international bibliographic database Scopus was used to select publications for the review. To consider the national specifics of research, the sample was expanded to include articles from the Russian Science Citation Index (RSCI).
Results. The article reviews and summarizes the existing scientific approaches to identifying creative industries, highlights the main debatable issues of terminology in the field of the creative economy. Based on a comprehensive review of the approaches of international and domestic researchers, the article presents a system of criteria for identifying creative industries, which are differentiated by types of sources, specifics, and results. The application of this system of criteria will allow us to determine the boundaries of creative industries and distinguish creative industries from the general array of economic sectors.
Conclusion. Systematization of theoretical approaches to defining and identifying creative industries is a necessary condition for their further classification and evaluation. The proposed system of criteria is a synthesis of existing approaches, which makes it universal and suggests the possibility of its practical application for solving a wide range of tasks related to managerial decision-making in the field of creative economy development.

KEYWORDS
creative economy, creative industry, cultural industries, knowledge economy, copyright industries, creative clusters, intellectual property

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Теоретические подходы к выделению креативных индустрий

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АННОТАЦИЯ
Актуальность. Актуальность исследования определяется возрастающим значением креативных индустрий в мировой экономике, что вызывает необходимость формирования общих подходов к определению и выделению креативных индустрий для принятия эффективных управленческих решений на государственном уровне. Отсутствие единого подхода в определении понятийного и методологического аппарата обуславливает необходимость дополнительных исследований по данному вопросу.
Цель исследования. Целью данного исследования является проведение сравнительного анализа подходов к выделению совокупности креативных индустрий, сложившихся в международном и отечественном академическом сообществе.

КЛЮЧЕВЫЕ СЛОВА
креативная экономика, креативная индустрия, культурные индустрии, экономика знаний, индустрии авторского права, креативные кластеры, интеллектуальная собственность

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Данные и методы. Исследование построено на основе метода Scoping review, подразумевающего полноценный анализ существующей литературы в разрезе ключевых концепций в рассматриваемой области исследований. С целью формирования выборки публикаций для обзора была использована международная библиографическая база данных Scopus. Для учета национальной специфики исследований выборка была расширена включением статей из Российского индекса научного цитирования (РИНЦ).
Результаты. В статье проведен обзор и обобщены существующие научные подходы к выделению креативных индустрий, освещены основные дискуссионные вопросы терминологии в сфере креативной экономики. На основе комплексного обзора подходов зарубежных и отечественных исследователей представлена система критериев выделения креативных индустрий, дифференцированная по видам источников, специфике и результатам. Применение данной системы критериев даст возможность определения границ креативных индустрий и выделения креативных индустрий из общего массива экономических отраслей.
Выводы. Систематизация существующих в теории точек зрения к определению и выделению креативных индустрий является необходимым условием для их дальнейшей классификации и оценки. Предложенная система критериев является синтезом существующих подходов, что делает ее универсальной и предполагает возможность ее практического применения для решения широкого спектра задач, связанных с принятием управленческих решений в сфере развития креативной экономики.

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识别创意产业的理论方法

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摘要
现实性：创意产业在全球经济中日益增长的重要性决定了这项研究的现实意义。这就需要形成共同的方法来定义和选择创意产业，以便在州一级进行有效的政府决策。由于在定义概念和方法论方面缺乏统一的方法，有必要对这个问题进行更多的研究。
研究目标：本研究的目的是对国际与国内学术界出现的一系列创意产业方法论进行比较分析。
数据与方法：该研究以范围综述为基础，需要从有关研究领域的关键概念方面对现有文献进行全面分析。由国际书目数据库Scopus来生成综述所用的出版物样本。考虑到本国研究的特殊性，样本被扩大到包括俄罗斯科学引文索引(РИНЦ)的文章。
研究结果：本文回顾并总结了目前学术界对创意产业的认定方法，并强调了创意经济领域术语的主要争议性问题。本文在全面回顾国内外研究者方法的基础上，提出了一套按来源类型、特殊性和结果进行区分的创意产业标准体系。这套标准体系的应用将有可能界定创意产业的边界，并将创意产业从一般的经济部门中区分出来。
结论：对现有的关于定义和识别创意产业的理论观点进行系统化，是对其进一步分类和评估的前提。拟议的标准体系是现有方法的综合，它具有普遍性，且具有实际应用的可能性。该标准可以解决与创意经济发展领域的管理决策相关的广泛任务。

关键词
创意经济、创意产业、文化产业、知识经济、版权产业、创意集群、知识产权

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Introduction

Creative economy is a relatively new concept that entered the scientific and political discourse at the end of the 20th century. However, despite its novelty, this phenomenon is of great interest to scientists, experts, economists, politicians, and representatives of civil society (Durey, 2021). High attention to this issue is caused by the following circumstances.

Firstly, creative industries are becoming more significant as a new driver of economic growth. The share of the creative sector in the economy is already quite noticeable and will grow significantly in the future. According to the World Intellec-

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tual Property Organization, this sector accounts for 5.1% of global GDP and 5.3% of total employment. According to the UNESCO methodology, the share of creative industries in global GDP was about 3% in 2015. In 2020, the gross value added of the creative industries in Russia amounted to 2.7 trillion rubles. In terms of the share of creative industries in GDP (2.7% in 2020), Russia is still behind the leaders in this field – the United States and China, where the same indicator amounts to 4.2% and 4.3%, respectively[1].

Secondly, creative industries attract a highly educated, skilled workforce. Such workers are "qualified consumers" of material and spiritual goods, informal leaders of public opinion. Employment in the creative economy grew even at the peak of the pandemic (from 3.9 to 4.8 million people in 2017–2020[2]). In 2020, 4.7% of all employed people worked in creative professions, and 70% of them had higher education[3].

Thirdly, the development of the creative economy is an important factor in overcoming social exclusion and inequality, and it contributes to urban and social revival (Tajtáková, M. & Olejárová, M., 2021). The creative economy is particularly important for enabling full and productive activity, creating decent jobs, stimulating entrepreneurship, promoting the formalization and development of micro-, small- and medium-sized enterprises (Borsekova et al., 2021), encouraging social inclusion (Mengi, O. & Guaralda, M., 2021). 61% of those employed in the creative industries of Russia work in small- and micro-businesses[4]. There are especially many creative businesses in the segment of individual entrepreneurs.

The growing attention given to the development of the creative economy is evidenced by the fact that the UN General Assembly declared 2021 the "International Year of the Creative Economy for Sustainable Development" (UN resolution A/RES/74/198 of December 19, 2019).

Meanwhile, despite the circumstances, many issues related to the development of the creative economy have not yet attracted the attention of scientists. There is no unity in understanding the composition of the creative industries included in the creative economy. Justification of decisions in economic policy is not always based on a fundamental science. The specificity of the composition of creative industries in countries with different types of socio-economic and political systems is underestimated.

The concept of creative industries entered academic discourse when the term "Creative Industries" was first used in the 1994 "Creative Nation of Australia" report. However, it received worldwide recognition four years later, in 1998, when the UK Department for Culture, Media and Sports (DCMS) published the Creative Industries Mapping Document. The DCMS report made the first scientific attempt to define creative industries. According to the DCMS definition, creative industries are all industries that require "creativity and talent that have the potential to enrich and create jobs through the use of their intellectual property". This was followed by definitions proposed by the European Commission[5], which defined creative industries as industries that use culture as an input, and by UNCTAD[6], which focused on the creative aspect and considered creative industries as a set of creative economic activities. The ensuing formalization of the concept of creative industries has given impetus to the practical creation of a new cultural and creative environment (Maddah et al., 2021), which promotes the development of cities and the economic development of regions (Liang, S. & Wang, Q., 2020). However, the study of creative industries has remained an intellectual challenge.

According to Howkins (2001), an apologist for the creative economy, neither creativity nor economics are new, but the nature of their relationship and how they are linked to create special value and wealth is. Howkins uses the term "creative economy" broadly, and it includes fifteen creative industries: advertising, architecture, arts, crafts, design, fashion, film, music, performing arts, publishing, research and development, soft-

[1] Creativeization of the entire economy. News portal of the HSE Institute for Statistical Research and Economics of Knowledge (02.11.2021). Available at: https://issek.hse.ru/news/525365722.html?ysclid=l9a599akaj263104583

[2] Effects of the corona crisis on the creative economy. News portal of the HSE Institute for Statistical Research and Economics of Knowledge (26.10.2021). Available at: https://issek.hse.ru/news/522653516.html?ysclid=l9a5fb017q717341535

[3] Creativeization of the entire economy. News portal of the HSE Institute for Statistical Research and Economics of Knowledge (02.11.2021). Available at: https://issek.hse.ru/news/525365722.html?ysclid=l9a599akaj263104583

[4] Ibid.

[5] European Commission (2011). Priority Sector Report: Creative and Cultural Industries. TheEuropean Cluster Observatory, Luxembourg: Publications Office of the European Union, 43 p.

[6] UNCTAD (2008). Creative Economy Report 2008, UNCTAD.

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ware, toys and games (excluding video games), television, radio, and computer games.

Most researchers view creative industries as a key driver of economic growth, both nationally and globally (Lei, 2021). According to Muller et al. (2008), creative industries perform three roles. Firstly, creative industries are the main source of innovative ideas, thus contributing to the creation of new products and services. Secondly, creative industries offer services that can contribute to the innovation activities of other businesses and organizations inside and outside of creative industries. Thirdly, creative industries require adaptation and new technological developments, providing an innovative impetus for technology producers. In addition, creative industries are an important sector for economic growth and development not only in terms of creating jobs or expanding economic activity, but also due to their role in promoting economic evolution by contributing to behavioral, social, and institutional evolution (Potts, 2009). Culture as a shared value can influence efficiency, equity, or the setting of economic and social goals. These individual effects combine into collective outcomes and influence macroeconomic outcomes such as GDP, technology performance, employment, structural change, income, and welfare programs (Throsby, 2010).

It should be noted that studies aimed at identifying the contribution and impact of creative industries and creative employment on the regional economy demonstrate a growing interest in this area. According to Professor Florida (2004), who is known for the concept of the creative class and its role in "urban regeneration", the interest stems from the fact that creativity is seen as a driver of growth and is associated with high levels of economic development. The works of Marco-Serrano et al. (2014), Stam et al. (2008), Snowball (2016), Eikhof & Haunschild (2007) establish that countries and regions with a significant concentration of the creative class have a competitive advantage, and that there is a causal relationship between GDP per capita and employment intensity in the creative industries.

John Howkins (2001) and Richard Florida (2003) also argue for the close relationship between creativity and innovation and productivity growth as a key driver of economic growth, competitiveness, as well as economic and social well-being. Howkins and Florida point out that creative industries have a strong innovative potential, they influence innovation processes and knowledge-based growth in other areas of the economy, impacting value chains horizontally and vertically as suppliers and customers. Moreover, a broad interpretation of creativity led to Richard Florida's theory (2002) of the emerging creative class – a group of professional, scientific, and artistic workers operating in conditions of economic, social, and cultural dynamism, especially in urban areas. The creative class is the main lever for the development of culture and civilization in the modern era (Florida, 2016).

Even though various aspects of the creative economy are widely covered in the scientific literature, a comprehensive understanding of the essence of creative industries has not yet been formed. This leads to a plurality of terminology and the existence of different approaches to identifying creative industries.

To identify the relevance of scientific topics and scientific gaps, we selected 34 review articles over 19 years based on a thematic sample from the Scopus database (see Methods and Data chapter), which also included publications with more than 100 citations (n = 4). There were also six articles with 1 citation and three articles that had not yet been cited, two of which were published in 2021. However, these publications were included in our review due to their recent release date, given that the age of the article has a significantly greater effect on the citation growth than its relevance (Raitskaya & Tikhonova, 2020). The most highly cited publication (415 citations as of July 21, 2022) is "Creativity and tourism. The state of the art" (Richards, 2011). The selected 34 publications were published in 28 journals, of which more than one publication was published in 6 journals. The most highly cited reviews appeared on the pages of Annals of Tourism Research and Urban Studies, which indicates the demand for urban and sectoral studies.

28 out of 34 review articles belong to the "Social Sciences" field: "Geography, Planning and Development" (17), "Urban Studies" (4), "Sociology and Political Science" (1), Social Sciences (miscellaneous) (6). The remaining 6 articles belong to the following scientific areas: "Business, Management and Accounting" – 4; "Economics, Econometrics and Finance" – 2. The revealed distribution confirms that a comprehensive study of creative industries in the scientific field is interdisciplinary in nature (which is reflected in the literature on urban planning, geography, economics, and cultural studies) and leads to the borrowing

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of definitions without clear explanations (Chapain & Sagot-Duvauroux, 2021; Durey, 2021). This inconsistency is most clearly manifested when conducting regional studies (Correa-Quezada et al., 2018; Dunska & Marcinkevica, 2017; Agustina et al., 2020). In Russian literature, creativity is also considered in a cross-scientific context and is a subject of interest for psychology, sociology, cultural studies, economics, and political science (Matsko, 2021). In this regard, we can assume that the interdisciplinarity of the creative economy may be one of the main reasons for the terminological plurality, since this phenomenon is considered from different points of view depending on the scientific direction of research.

Review articles come from authors with affiliations at universities and research centers in the following countries: UK (8); USA (4); Australia (4); Spain (3); Germany (2); Turkey (2); Singapore (2); Netherlands (1); Mexico (1); Argentina (1); France (2); Italy (1); Hungary (1); South Africa (1). A total of 14 countries are represented. There are no scientists with Russian affiliation and nationality among the authors. Therefore, the academic discourse of Russian authors on the topic of creative industries is not reflected in the international scientific community.

The analysis of thematic clusters shows that most review articles are on the topics of regional policy in the field of cultural industries and urban transformation in the context of the creative economy (Table 1). The least represented cluster in review articles is a theoretical block of articles aimed at understanding the essence of the creative

Table 1

Main thematic clusters of review articles on the creative economy

Cluster Title	Review Number	Content
Creative clusters Creative placemaking	6	This cluster discloses the concept of creative placemaking within the framework of a creative city, analyzes the development strategy for creative placemaking, the creation of network organizations of creative and cultural industries. It studies the prerequisites for the emergence of creative clusters and the contribution of city districts with a different set of creative clusters to the processes of urban renewal.
Development of individual industries of the creative economy Creative industries	5	This cluster considers individual creative industries and their impact on the perception of cities. In particular, it studies the relationship between tourism and creativity, the rationale for the «creative turn» in tourism studies, with a focus on cultural tourism and non-material culture. It assesses the impact of large-scale entertainment events on the economic development of the city. It assesses how the presence of professional and creative classes is changing the economy and the retail landscape, using the example of a study of coffee shops.
Regional (city) policy in the field of cultural industries Cultural policies	7	This cluster covers the issues of urban cultural policy, cultural planning, and cultural neighborhood, and it studies models of progressive cultural districts. It studies the policy of urban regionalism in a comparative aspect. It considers issues of attracting creative employees in the territory and determines factors reflecting the most attractive territories for innovation.
Urban transformation	10	The cluster examines the transformation of the meaning of cities for people in connection with the development of creative industries, as well as the development of sectors of the creative economy in medium and small towns. In particular, it explores the revival of industrial territories due to their multifunctional use by representatives of creative industries; contradictions of social interactions concerning the use of the territories of the state/business/people of creative professions who are far from the economic exploitation of creativity; issues of innovative urban brand management strategies.
Modeling and measurement of creative industries	3	This cluster actively explores the impact of cultural and creative industries (in terms of social, economic, and environmental impact) on the development of regions. It shows that cultural industries improve the development of the regional and local economy. Research is driven by a lack of tools to evaluate the contribution of these innovations.
Theoretical understanding of creative industries Rethinking creative industries research	3	The articles focus on the definition of the term "cultural industry", the measurement of cultural industries in an international context, as well as the identification of intercountry differences. There is a spatial dynamic that highlights the key importance of the development features of creative industries in cities. The cluster addresses the differences in understanding creative industries in the reports of international organizations and theoretical approaches. It considers the implications and limitations of some theoretical approaches to creative industries clustering in order to understand the geography and development of creative industries; it argues that existing literature treats these approaches "separately", without recognizing the importance of other actors and forces.

Source: developed by the authors based on 34 review articles

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economy. Review articles that attempt to systematize the criteria for classifying creative industries (Pererva, 2021) are based on an analysis of the totality of approaches of international organizations and the scientific community, which does not allow us to determine the contribution of scientists to this topic.

Russian authors began to include the creative economy in the academic discourse in 2007–2008. In early publications, the creative economy was considered in the context of the transition to a post-industrial economy and the importance of human capital as the main intellectual asset (Savina, 2008; Berezhnaya, 2008). At that time, the need to identify and classify creative industries was determined by the emerging Russian practice; the gaps in theory were often closed by the studies of international authors and the canonical approach of the international organizations DCMS, UNCTAD, and UNESCO. All of it was reflected in the practice-oriented approach to research at the time.

An analysis of the dynamics of Russian scientific publications reveals that researchers showed low interest in the topic of creative industries in 2008–2012 (approximately 20 articles per year in the RSCI database). A sharp increase in publications (70 articles per year) on the topic of the creative economy was observed in 2014, which can be explained by the introduction of creative industries at the legislative level[7]. Research of that period is characterized by an interest in the issues of legislative support for creative industries (Lavrinenko, 2015), as well as the development of certain types of creative industries in Russian regions (Shcherbakova, 2015; Demidov & Komarova, 2014). The demand for a solid theoretical basis necessitated research that offered original approaches to the definition of the terminological apparatus (Kuznetsova, 2022) and systematization of accumulated international experience (Khestanov, 2018).

Thus, at the moment, neither international nor Russian scientific literature has a consensus on the definition of creative industries, as well as the criteria for their evaluation and identification. There is also no standard methodology for measuring the impact of creative industries on the economy. According to Hui (2007), this means that the creative sector is a growing economic area with a valuable contribution to the local economy and significant job creation potential. Therefore, the study of contradictions in the definitions of creative industries and criteria for their evaluation remains a topical issue. Theoretical clarity on this issue will contribute to the development of effective policies and the adoption of correct management decisions in the field of creative economy.

The need to "fill in" the resulting theoretical gap led us to formulating the purpose of our study and research objectives.

The purpose of the study is to conduct a comparative analysis of approaches to identifying the totality of creative industries that have developed in the international academic community. The authors base the research on the assumption that there is, firstly, a logical and meaningful continuity of research practices; secondly, the cross-country and interdisciplinary specificity of approaches to identifying creative industries.

Research objectives:

– to generalize and systematize approaches to defining the creative economy and identifying creative industries used in the economic policy development;

– to develop a system of criteria for identifying creative industries based on a review of established research practices;

– to substantiate the practical significance of theoretical approaches to identifying creative industries.

Methods and data

The study is based on the Scoping review method – a full analysis of the existing literature in the context of key concepts in the specific area of research for a certain period. Such reviews are used mainly for the purpose of summarizing previously obtained results in a certain subject area, identifying the types of existing research, clarifying terms and concepts, identifying key characteristics or factors associated with the concept, identifying gaps in existing research (Munn et al., 2018). A scoping review, unlike a systematic review, usually does not include criteria for assessing the quality of existing studies. A scoping review is often a precursor to a systematic review.

The international bibliographic database Scopus, which is published by Elsevier, was used to form a sample of publications for review at the first stage. All periodicals in Scopus are checked by the Content Selection & Advisory Board, the quality of publications is assessed by the h-index,

[7] Fundamentals of the state cultural policy (approved by Decree of the President of the Russian Federation dated December 24, 2014 No. 808 "On approval of the Fundamentals of the state cultural policy").

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CiteScore, SCImagoJournalRank (SJR), Source Normalized Impact per Paper (SNIP). The articles in Scopus were selected on the basis of cross-requests for three groups of keywords: research subject, analyzed process, types of cities in the research focus (Table 2). The resulting database contains 843 articles published in 415 journals since 1998 (Table 2). Number of review articles – 34, articles – 556, books, book chapters – 237, conference papers – 9, editorials – 5.

To consider the national specifics of research, the sample was expanded to include articles from the Russian Science Citation Index (RSCI). RSCI is a national bibliographic database of scientific citations, which contains more than 12 million publications of Russian authors, as well as information on the citation of these publications from more than 6,000 Russian journals. Lists of publications in the RSCI database were formed based on the following keywords: Creative Industries, Creative sector; Creative economy; Cultural Industries, Cultural sector; Experience economy; Knowledge-based economy; Copyrights Industries, Copyright-Based Industries. The generated database contains 386 articles published in 239 journals since 2009.

Subsequently, the review procedure consisted of structuring concepts, approaches, and research methods based on the publications by international and Russian researchers.

The article is organized as follows. First, we examined the existing points of view on the pairs of concepts "cultural industries" and "creative industries", "creative economy" and "creative industries", on the basis of which we identified key approaches to these definitions. After that, we reviewed the approaches to identifying creative industries proposed in the scientific literature. Based on a comprehensive review, we systematized the criteria for classifying industries as creative industries. Finally, we substantiated the practical significance of theoretical approaches to identifying creative industries.

Results

Despite the fact that there are many publications devoted to the creative economy sector, a single concept of identifying creative/cultural industries has not yet been adopted. This is reflected in the numerous synonyms for the creative economy used in different countries: Creative Industries (sectors), Cultural Industries (sectors), Experience Economy, Orange Economy. Russian scientific literature is also characterized by terminological diversity. The following alternative definitions are used: "leisure industry" (Matsko, 2022), "entertainment industry" (Kamalov, 2021), "experience economy" (Kolodnyaya, 2022; Shchurina, 2022), "creative industries" (Gorbovskaya, 2020), "knowledge economy" (Ovtsinova, 2018), but the most common terms are "creative economy" and "creative industries".

The first point of interest is the lack of "theoretical clarity" in the definition of creative industries, one of the reasons for which is their complex structure and various approaches to their identification (Cunningham, 2002). Terminology lacks rigor, it is often inconsistent and "confusing" (Galloway & Dunlop, 2007). The lack of consensus in the definition is primarily due to the absence of a generally accepted system of criteria for identifying types of activities that classify industries as "cultural" and "creative". Differentiation of definitions inevitably leads to different groupings of creative industries being enshrined in the regulatory documents of different countries, and even greater diversity in the scientific literature.

Scientific approaches to identifying creative industries

Cultural and creative industries

The terminological plurality of concepts in the field of creative economy does not always mean that the proposed terms are synonymous. In particular, even though some countries (Germany, Poland, Italy, New Zealand) and organizations (The World Bank) identify cultural industries

Table 2

Groups of keywords for article selection

Research subject	Processes	Types of cities
Creative economy Creative industries Creative city Creativity city criteria Creativity industries criteria Creativity criteria evaluation	Digital transformation Reindustrialization Urban policy Urban renewal Urban regeneration	Second tier city Secondary city Company town Resource town Industrial city

Source: compiled by the authors

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(cultural sector) within "creative industries (creative sector)" at the level of regulatory documents (Zhuravleva & Tokarev, 2021), research opinions on this issue are divided. The terms "cultural industries" and "creative industries" are often used interchangeably. The works of Garnham (2005), as well as Galloway and Dunlop (2007), can be noted among the studies that analyze the transition from cultural to creative industries.

In 2002, Cunningham (2002) offered an explanation for the difference between cultural and creative industries. He argued that the latest phase of technological change, including the Internet and digitalization, had supplanted the old concept of cultural industries: while the "classic" cultural industries emerged from the technological advances of the early twentieth century, the creative industries are the product of the technological changes of the late twentieth and early twenty-first centuries. Another explanation can be found in the work of Hesmondhalgh (2013), who points out that creative industries represent a natural evolution of cultural industries, and that both deal with "the specific dynamics of symbolic production and circulation, and the main difference between the two terms is a less clear understanding of the role of culture or creativity in contemporary economies and societies"".

An original approach was proposed by Zuev and Vasetsky (2010), who suggested that all industries are cultural industries, as they are a means of reproduction and consumption of culture. For example, clothing, furniture, workplace equipment, communication methods – everything is part of the culture, and everything is put on an industrial basis in one form or another.

The article by Miège (2018), which is the result of a 20-year theoretical search for combining creative and cultural industries into a single definition, concludes that the diversity of activities of the creative economy leads to diversity in legislative regulation, professional standards, and the logic of functioning, which does not allow these industries to be combined in one cluster. However, the author highlights similar elements of creative and cultural industries that can be observed in the content of the final product – namely, its creative component. According to Zaikin (2022), who also distinguishes these concepts, cultural industries offer predominantly "a mass product based on a single developed idea, which is then scaled up industrially. Creative industries are dominated by a more artisanal mode of production, and the emergence and discussion of an idea can occur in a manner similar to cultural industries".

Another pool of authors shares the broad understanding of creative industries without separating the cultural and creative components, justifying this with a common creative component (Amosova, 2022; Gambeeva, 2021; Bukata, 2018; Weinmeister & Ivanova, 2017). Thus, cultural and creative industries are united by a common criterion of the creative component in the process and as a result of their activity, which allows us to distinguish these industries from the general array of activities.

Creative economy and creative industries

The analysis of sources revealed two points of focus on the definition of terminological apparatus. The first group of authors follows a conceptual path, separating the creative economy from the traditional one, and focuses on a broader concept than "creative industries" – "creative economy". The advantage of this approach is the ability not only to identify areas of activity related to creative industries, but also to theoretically comprehend and qualitatively describe the essence of creative product making, as well as to characterize the participating economic agents.

In particular, Gushchina (2022) defines the creative economy as "a type of economy that differs from the traditional economy in that the production process is not based on traditional types of resources, while the value of the product is increased due to the imagination and creativity of its creator". Thus, the author emphasizes the lack of the need for production funds[8]. R. Cushing (2001) comes to a similar conclusion, introducing the broad term "creative capital" and claiming that the knowledge-intensive basis of the creative economy is built on a social rather than a material basis. Kovaleva (2022) considers the creative economy as an independent economic sector, highlighting its distinctive feature – creation of high value-added by evaluating the creative component of the creators' work, which also correlates with previous positions. The definition of creative economy through value added is quite common (Baryshnikov, 2021), which indicates the authors' intention to highlight its economic component. Thus, most studies use value added (as a percentage of gross domestic product) as

[8] Note: this statement is debatable, since some generally recognized areas of CI, for example, software development, require a high level of technical equipment, which necessitates production funds.

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the main indicator of the development of creative industries (Dunska & Marcinkevica, 2017). Russian studies also take into account the gross regional product[9].

Several publications emphasize the knowledge component of the creative economy and call creative industries "cognitive" (Romanets & Danilidi, 2022). Thus, Sung (2015) defines the creative economy as "a policy that aims to generate new growth through economic operations that promote creativity, knowledge convergence, and advanced scientific technology based on coordinate learning, consequently creating new markets and new jobs". A similar approach is presented in the article by Kuznetsova (2022), where the creative economy is considered from the point of view of the activity characteristics, which include basing activities on knowledge and cultural values, emphasizing the importance of the relationship between human creativity and ideas, knowledge, and technology. Thus, the creative economy is based on the unlimited potential of intellectual capital.

Approaching the definition through the term "creative industries" has its own characteristics and emphasizes the fact that the studied phenomenon is primarily a set of creative industries (Romanets, 2022). The advantage of this approach is the ability to determine the boundaries of the creative economy, and, therefore, to quantify its scale. Definitions of this type are often focused on the intellectual component of creative industries. Thus, Kazakova (2020) defines creative industries as a new "analytical definition of the industrial components of the economy, in which creativity is the source material, and content or intellectual property is the result". Molchanov (2022) characterizes creative industries in a normative style, defining them as "areas of activity in which legal entities and individuals who own intellectual property are in a state of creative and cultural activity, producing goods and services that have economic value, contribute to the development of the individual and improve the quality of life". Thus, this approach seems to be more practice-oriented, since it characterizes industries related to the creative economy.

Content analysis of the definitions of "reative industry" and "creative economy" shows that, in most cases, authors identify creative industries based on the following parameters: intellectual and creative basis of activity, creation of high value-added due to the creative component, as well as the product of creative industries being considered an object of intellectual property.

Criteria for identifying creative industries

The objective basis of the problem of defining creative industries is the difficulty in understanding the essence of creativity, "because it requires many resources such as intellectual skills, knowledge, motivation, personality, thinking style and environment" (Sternberg, 2006). Creativity can manifest itself in an individual (Kaufman & Sternberg, 2013), in teams (Gilson, 2013) and in networks (Cattani et al., 2013). Creative people (teams, networks), as well as commercial firms that profit from the results of creative work, are usually attracted to territories that offer the best conditions for their coexistence and interaction. As a result, some cities have more creative people than others (Lorenzen & Andersen, 2009; Florida,2002). Thus, creative industries involve not only individuals, firms, and cities, but also national and international state policies aimed at supporting and protecting national cultures and economic sectors (Bakhshi et al., 2013).

In practice, the lack of consensus on the definition of creative technologies creates difficulties in identifying specific activities that belong to the creative industries. This problem is aggravated by limited access to data, as well as difficulties in accurately calculating the share of each industry in the economy. There is no single approach to identifying companies that fall under the category of creative industries. When defining creative industries, researchers focus on the fact that in these industries, creativity is essentially an enterprise that manages creativity and intellectual property (Matheson, 2006). This approach allows us to include any industry in the creative industries. In this regard, the literature attempts to emphasize the criteria for classifying industries and activities as creative technologies.

In general, most definitions of cultural industries are based on a combination of 5 main criteria for classifying sectors of the economy as creative – creativity, intellectual property, symbolic meaning, use value, and joint goods (Galloway & Dunlop S., 2007):

• Creativity implies that creative industries are based on individual creativity. This principle is most clearly presented in the concept of the "creative class" by Florida (2002), where he formulates

[9] Vlasova V.V., Gershman M.A., Gokhberg L.M. et al. Creative economy of Moscow in numbers (2021). NRU HSE. 108 p. Available at: https://measurecreativity.hse.ru/

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the principle of 3T (technology, talent, tolerance). Florida argues that it is not technology per se that influences the world, but the concentration of human creativity in cities, since people are the main source of innovation.

• Intellectual Property represents an organizing principle for cultural industries. In this case, the sector of the economy is classified as a creative industry by its ability to generate intellectual property. This is the key factor in the works of adherents of the "knowledge" economy. Howkins (2002) argues that the term "creative industries" can be applied to any industry where "brain power is preponderant and where the outcome is intellectual property". Studies by Russian scientists are increasingly asserting that knowledge (symbiosis of a machine and a person) and the creativity of human and artificial intelligence are the key driving force behind the creative economy (Danilchenko, 2019). However, the ability to create knowledge, not just possess it, comes to the fore, that is, the ability to form one's own intellectual and creative resources (Melnikov, 2007). Accordingly, the consideration of this criterion allows us to contemplate not only individual creativity, but human creativity in general, including creativity in the business and scientific world.

• Symbolic "Goods" or "Symbolic Meaning". This criterion can constitute the basis of cultural industries, since the creation or circulation of symbolic meaning is the defining concept of culture, and the economic value of goods derives from or reflects their cultural value. Thus, creative industries include all activities that are eligible for public funding as "art". However, the understanding of what can be attributed to art in the era of global digital transformation is often ambiguous.

• Use Value. This criterion suggests that the prevalence of symbolic meaning over use value, or cultural value over functionality, is a necessary condition for cultural industries. Thus, the production of books, films, plays, music is part of the cultural industry, while activities such as fashion design, advertising, and architecture (which have symbolic content, but prioritize functionality) are not considered part of the cultural industry. This factor can be used as a criterion for distinguishing between cultural and creative industries.

• Joint Goods (according to Galloway and Dunlop). This criterion proposes to include not only industries that produce goods with symbolic meaning, but also industries where the proportion of "core cultural goods" is lower than in creative arts. However, this criterion cannot be exhaustive, since it is quite difficult to determine the proportions of the cultural and functional components for many goods (for example, design and architecture).

Other scientific approaches that characterize creative industries deepen the basic criteria. Thus, Throsby (2001) notes that cultural industries have three main characteristics: "they involve some form of creativity in their production; they are concerned with the generation and communication of symbolic meaning; their output embodies, at least potentially, some form of intellectual property". The criterion of symbolic meaning is explored in Throsby's concentric circles model, in which creative ideas begin as sound, text, and image in the core creative arts, and these ideas and influences diffuse outward through a series of layers, or "concentric circles". This model includes the following subgroups: core creative arts (literature, music, performing arts, visual arts), other core cultural industries (film, museums and libraries), wider cultural industries (heritage services, publishing, sound recording, television and radio, video and computer games) and related industries (advertising, architecture, design, fashion). The concentric circles model is the basis for the European classification of creative industries (Pererva, 2021).

In 2002, David Hesmondhalgh (2002) developed a model of symbolic texts that derives from the tradition of cultural studies. This approach focuses on culture and covers three sectors: core cultural industries (advertising, cinema, Internet, music, publishing, television and radio, video and computer games), peripheral cultural industries (creative arts), and borderline cultural industries (consumer electronics, fashion, software, sports). Core cultural industries, according to Hesmondhalgh, deal primarily with the industrial production and circulation of texts. Like the core cultural industries, "peripheral cultural industries are centrally concerned with the production of texts. But the reproduction of these symbols is based mainly on semi-industrial or non-industrial methods". Borderline industries have common features with cultural industries but differ significantly from them. The symbolic nature of creative industries is mentioned in the works of Granham (2005) and Lampel et al. (2000). The authors consider the first dimension of creative indus-

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tries to consist of semiotic codes, emphasizing the primacy of the "symbolic nature of creative goods". These codes are used by artists to give meaning to their work and form an image that is interpreted by the audience. A similar approach to identifying creative industries is presented in the work of Zuev (2010), who defines creative industries as technologies whose basic purpose is the mass production and circulation of texts that carry social value (meanings, codes of conduct, lifestyles, etc.).

Creative economy is based on the capital of ideas, not on physical capital; it develops on the basis of information and communication technologies. Thus, one of the most important features of a creative economy is the use of information in the creation of its content, i.e. information load (Melnikov, 2007). An additional feature is the growing demand for constant interaction between the authors of a creative product and its consumers. Fill (2009) called this process engagement: the greatest effect of the creative economy is found not in the traditional creative industries, but in the application of skills, entrepreneurship, and business models, as well as in the creation of organizational value, as in intellectual property management. This approach first appeared in 1997 in the work of fundamentalists M. Horkheimer and T. Adorno (1997), where the authors analytically proved that creative industries emerged due to the development of mass communication and globalization. Agreeing with this statement, Dronyuk et al. (2019) come to a new definition of creative industries, defining them as "unique economic sectors that are created through the spread of mass communication and globalism and are divided into two types: cultural and intellectual".

The analysis of approaches to defining creative economy and distinguishing creative industries from the general array of activities allowed us to identify a system of criteria in terms of sources, specifics, and results of creative industries (Table 3).

Practical significance of theoretical approaches to identifying creative industries

The practical significance of research on creative economy and creative industries is difficult to overestimate, since it is the theorists who pull the "creative lever" to improve advanced sectors of the economy. The innovative component of

Table 3

Criteria System of Creative Industries

№	Criteria	Authors	Comments
		1. Sources of creative industries	
1.1	Creativity (creative potential of the individual)	Florida (2002); Miège (2018); Amosova (2022); Gambeeva (2021); Bukata (2018); Weinmeister & Ivanova (2017); Galloway & Dunlop S. (2007); Kazakova (2020); Kaufman & Sternberg (2013); Cattani et al., (2013); Gilson (2013)	Creativity can be defined as individual, in teams, in networks
1.2	Mass communication and globalism	Horkheimer & Adorno (1997); Dronyuk et al. (2019); Melnikov (2007); Fill (2009)	Development is based on information and communication technologies
1.3	Non-material basis of activities	R. Cushing (2001); Gushchina (2022), Zuev (2010)	Non-material basis is expressed in the low demand for traditional resources
		2. Specifics of creative industries	
2.1	Prevalence of symbolic value of a creative product over its functionality	Galloway & Dunlop S. (2007); Throsby (2001); Hesmondhalgh (2013); Zuev (2010)	Symbolic value is transferred through the circulation of texts that carry social value
		3. Result of creative industries	
3.1	New type of knowledge based on the creative component	Howkins (2002), Danilchenko (2019), Melnikov (2007); Sung (2015); Romanets & Danilidi (2022); Kuznetsova (2022)	Knowledge also acts as a symbiosis of human and artificial intelligence
3.2	High value-added due to the creative component of labor	Dunska & Marcinkevica (2017); Kovaleva (2022); Gushchina (2022); Baryshnikov (2021)	High value-added is an evaluative characteristic of human creativity
3.3	Intellectual property generation	Howkins (2002); Galloway & Dunlop S. (2007); Molchanov (2022); Kazakova (2020); Matheson (2006)	Intellectual property is the organizing principle

Source: developed by the authors based on the review of sources

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activity is not only a condition for market success, but also a guarantee of the national economy competitiveness (Matsko, 2021). However, applied solidarity on the issue of creative industries has not yet been found in theory.

Measuring the exact size of creative (cultural) industries causes the most controversy among economists and experts (Howkins, 2002; Throsby, 2010). Adorno (2001) argues that the development and evaluation of cultural industries absorbs "serious art" and brings culture to uniformity and forced equivalence. He believes that the combination of economy and culture stimulates the creation and trade of cultural value, which contributes to the loss of the uniqueness and essence of cultural goods. Consequently, cultural goods should not be subject to classification and evaluation. However, most scientists focus on creative goods that allow scientists and policy makers to track creative processes (Hirsch, 2018). These goods, which artists use to generate new meanings and experiences, are evaluated as creative ones. However, the broad definition of creative technologies does not allow us to determine the extent to which these goods are the result of creative industries, and this, in turn, does not allow us to develop an appropriate set of policy responses. Consequently, the problem again rests with the lack of unity of criteria for identifying creative industries.

It is important to note that the main factors behind the extremely rapid growth of creative industries around the world are related to both technology and economics. The digital revolution and the economic environment in which this revolution took place have merged and created conditions for the growth and development of a new economy. The speed of technology development does not allow us to come to a single "correct" understanding of the set of creative industries for the productive development of this industry (Papushina, 2012). Therefore, theoretical approaches to defining and identifying creative industries must withstand the passage of time and be universal, which will allow us to identify them by specific economic decisions.

Thus, in order to find a practical reflection of the theory, we must have common theoretical positions that allow us to identify, classify, and evaluate creative industries. In this case, the policy in the field of creative economy has every chance of being successful and effective.

Conclusion

A comprehensive analysis of the existing theoretical base on the creative economy shows that terminological plurality and variety of approaches to identifying creative industries are one of the key problems in this scientific field. This is quite natural and can be explained by the interdisciplinarity of the studied phenomenon. However, pluralism of opinions generates different prerequisites for classifying creative industries, which, in turn, lead to significant discrepancies in strategic planning documents and regulations in different countries.

A review of scientific sources shows that the discussion about the unity of and difference between cultural and creative industries is partially resolved by identifying the general criterion of the creative component in the process and as a result of activities within these industries. Considering approaches to the definitions of "creative economy" and "creative industries" allowed us to contemplate this phenomenon in more detail. In the first case, a broad view of the creative economy allowed us to identify the knowledge component of the creative economy and highlight the criterion of high value-added due to the creative component of the creators' labour. In the second case, the emphasis is most often placed on the intellectual component of creative industries.

The study also shows that most approaches to defining cultural industries are based on a certain combination of criteria, which, in turn, are the basis for classifying economic sectors as creative ones. The differences lie in the emphasis that the authors place in their approaches depending on the direction of research.

The presented system of criteria (Table 3) is a synthesis of points of view, which are accepted by the scientific community, on the essence of creative industries. It is important to note that all the identified criteria are reflected in both international and domestic studies. This allows us to forego focusing on the usual differences and focus on the unity in understanding the essence of creative industries. Moreover, this allows us to assume the existence of universal principles (expressed in the form of criteria) underlying the creative economy, despite cross-country differences and the interdisciplinarity of the studied phenomenon. The identified criteria do not contradict each other, which allows them not only to coexist, but to complement each other. The system of criteria based on the principle of sources-specifics-result allows us to determine

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the boundaries of creative industries at key stages of creating a creative product.

Further research on the creative economy may include a review of approaches to identifying creative industries and their classification by international, expert, and consulting organizations, as well as an analysis of Russian legal documents at the federal, regional, and local levels. The next stage of research may include a comparison of the results of studying theoretical and practical approaches, as well as the further development of recommendations for the authorities in order for them to make informed management decisions in the field of the creative economy.

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Debt Policy for the Sustainable Development of Russian Regions and Megacities

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ABSTRACT

Relevance. In recent years, the role of ESG (Environmental, Social and Governance) bonds has been rapidly growing in the world. ESGs are used to raise funds for programs for sustainable development of territories.

Research objective. The paper studies the cases of Russian regions using green bonds and considers the prospects of this tool in the Russian context.

Data and Methods. The analysis focuses on the debt indicators of Russian regions and related budgetary indicators based on open source data from the Ministry of Finance, the Treasury, and independent rating agencies. The methods of comparative and retrospective analysis are used to identify the state and features of regional debt policy.

Results. Our analysis of the debt policy of Russian regions and megacities shows a low level of their activity in the stock market as issuers of bonds. This can be explained by the complexity of the system of subnational finances and the role of the Federation in preventing default situations, and therefore the priority use of budget loans. The city of Moscow was a pioneer in this matter in Russia. This determines the uniqueness of Moscow's experience in implementing debt policy.

Conclusions. The expansion of the green bond practice will allow Russia to move forward in achieving the goals of ESG agenda, which, despite the large-scale sanctions imposed on Russia at the moment, still remains relevant.

KEYWORDS
Russia, regions, megacities, regional budget, regional debt, green bonds, sustainable development, ESG policy

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Долговая политика для устойчивого развития регионов и мегаполисов России

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АННОТАЦИЯ

Актуальность. В последние годы в мире стремительно растет роль ESG (Environmental, Social and Governance) облигаций. ESG используются для сбора средств на программы устойчивого развития территорий.

Цель исследования. В статье исследуются кейсы использования «зеленых» облигаций российскими регионами и рассматриваются перспективы использования этого инструмента в российских условиях.

Данные и методы. Основное внимание в анализе уделяется долговым показателям регионов России и связанным с ними бюджетным показателям на основе открытых данных Минфина, Казначейства и независимых рейтинговых агентств. Для выявления состояния и особенностей региональной долговой политики используются методы сравнительного и ретроспективного анализа.

Результаты. Наш анализ долговой политики российских регионов и мегаполисов показывает низкий уровень их активности на фондовом рынке как эмитентов облигаций. Это можно объяснить сложностью системы субнациональных финансов и ролью Федерации в предотвращении дефолтных ситуаций, а значит, приоритетным использованием бюджетных

КЛЮЧЕВЫЕ СЛОВА
Россия, регионы, мегаполисы, региональный бюджет, региональный долг, зеленые облигации, устойчивое развитие, ESG-политика

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кредитов. Пионером в этом вопросе в России была Москва. Это определяет уникальность опыта Москвы в реализации долговой политики.
Выводы. Расширение практики зеленых облигаций позволит России продвинуться вперед в достижении целей ESG-повестки, которая, несмотря на масштабные санкции, наложенные на Россию в настоящий момент, по-прежнему остается актуальной.

ДЛЯ ЦИТИРОВАНИЯ
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俄罗斯地区和超级城市可持续发展的债务政策

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摘要
现实性：近年来，ESG（环境、社会和治理）债券的作用已迅速增长。ESG 为可持续发展项目筹集资金。
研究目标：本文研究了俄罗斯地区使用“绿色”债券的案例，并讨论了在俄罗斯背景下使用该工具的前景。
数据与方法：分析的重点是俄罗斯各地区的债务指标和相关预算指标，其依据是财政部、联邦国库和独立评级机构的公开数据。识别区域债务政策状态和特征，需运用比较和回顾分析法。
研究结果：我们对俄罗斯地区和超级城市的债务政策的分析表明，他们作为债券发行人在股票市场上的活动水平很低。这可能因为地方财政系统的复杂性，或者联邦因防止违约情况发生因此优先使用预算贷款。在这个问题上，莫斯科是俄罗斯的先驱。这决定了莫斯科在实施债务政策上有独特经验。
结论：绿色债券的扩大将使俄罗斯能够推进ESG议程。尽管目前俄罗斯经受了广泛的制裁，但该议程仍然具有现实意义。

关键词
俄罗斯，地区，超级城市，地区预算，地区债务，绿色债券，稳定发展，ESG政策

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Introduction

Modern development of territories is impossible without significant investment. Different regions and cities use various methods to attract funding. As a rule, regional or local authorities use borrowed funds to finance large investment projects. The use of this approach makes it possible to link the maturity of obligations to the economically useful life of a project, which is a preferable option in comparison with financing the entire cost of the project only from the region's current income. This is an optimal approach to the financial policy of borrowing in regional development. Borrowing is an important source of budget funds at the subnational level in both federal and unitary states (Boadway et al., 2018). Borrowing is the most popular source of funds for public investment and it can be described as the golden rule of public finance (Ueshina, 2018).

Despite Russia's wealth in hydrocarbons, the country supports the aspirations of the world community to combat climate change. Russia signed and adopted the Paris Climate Agreement in 2019, and as part of this agreement, in November 2020, the President of Russia issued a decree on reducing greenhouse gas emissions. Russia, however, is unlikely to copy energy-importing countries' approach to the green transition and climate policy instruments (Makarov, 2022).

For Russia, in the face of the global challenges, it is especially important to develop a model of the most effective fiscal policy in regions with a high level of financial independence. For regions heavily dependent on financial assistance from the federal budget, intergovernmental transfers will be the main factor of fiscal sustainability. For regions and cities with high levels of population concentration and high degrees of fiscal independence, measures should be devised to ensure sustainable development in the face of a potential crisis, lockdown and other emergency situations. In this regard, Moscow, being both a region (a constitutional subject

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of the Russian Federation) and the largest city in Russia, occupies a unique place in terms of fiscal policy.

Recently, the largest regions and megacities of the world have been actively implementing ESG (Environmental, Social and Governance) policies. Within this policy, the government's efforts are aimed at ensuring sustainable development, which includes the improvement of the environmental situation, transport infrastructure and urban environment. For such ESG projects, financing is raised mainly through bonded loans or so-called green bonds. Green bonds are fixed-income securities designed specifically to finance or re-finance investments, projects, expenditure or assets helping to address climate and environmental issues. Both governments and companies use them to finance the transition to a more sustainable and low-carbon economy[1].

In 2021, the city of Moscow issued the first green bonds in Russia to finance environmental projects. This was a new step in the development of Russia's regional debt policy, which, due to geopolitical tensions and economic reasons, may undergo significant changes in the coming years. Thus, this study aims to evaluate the prospects of green bonds in Russia by solving several tasks:

– review the experience of using green bonds in Russia;

– analyze the data on the public debt and budgets of Russian regions as well as their credit ratings;

– conduct a retrospective analysis of bond issuance practices in Russian regions;

– review green bond issuance practices in the city of Moscow.

The events of March 2022 and the fourth round of European sanctions against the Russian Federation led the Big Three rating agencies to withdraw their credit ratings from Russia, its regions, and companies based in the Russian Federation. Basically, the ratings were first downgraded, then withdrawn. The Fitch Ratings agency withdrew the sovereign rating of all Russian companies on March 23, 2022, and the sovereign rating of the Russian Federation on March 25. At the time of the withdrawal, Russia's long-term and short-term issuer default ratings in foreign and local currency, as well as the rating of senior unsecured debt, were at the level of C, the ceiling of the country's rating was B–[2].

On March 31, international agency *Standard & Poor's Global Ratings* downgraded the ratings of Moscow, the Yamal-Nenets Autonomous District, Leningrad, Samara and Krasnoyarsk regions to "CC" and placed them on the review list with a "negative" outlook[3]. Similarly, *Moody's Investors Service* withdrew all the ratings of the Russian Federation and its regions. Along with the sovereign ratings, *Moody's* withdrew the ratings of cities Moscow, St. Petersburg, Krasnodar, Omsk, and Volgograd, as well as Moscow Region, Bashkortostan, Tatarstan, Chuvashia, Komi, the Khanty-Mansi Autonomous District, Krasnoyarsk and Krasnodar, Samara, Omsk and Nizhny Novgorod regions. The ratings of the two infrastructural companies *Vodokanal of St. Petersburg* and *Western High-Speed Diameter* were also withdrawn. At the time of the withdrawal, the ratings of Russia and all the above issuers were at the level of "Ca" with a "negative" outlook[4].

It should be noted, however, that the ban on assigning a credit rating to any Russian citizen or individual residing in Russia, legal entity established in Russia) that was part of the fourth package of the EU sanctions applies exclusively to credit ratings and does not concern the ESG ratings of Russian companies. Thus, the study of this tool is still relevant.

Theoretical framework

In the last decades, attempts have been made to find a balance between the interests of human society and nature, most interestingly in the effort of sustainable development[5]. The most concise definition in this regard is as follows: sustainable development is "socio-economic development driven by environmental protection and environmental safety" (Boklan, Kopylov, 2014). Thus, the sustainability of a national economy is its stability, security, ability for continuous development and evolution (Abalkin, 2011).

[1] Spinaci, S. European green bonds. A standard for Europe, open to the world. European Parliamentary Research Service. URL: https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698870/EPRS_BRI(2022)698870_EN.pdf (Date of access: 01.08.2022).

[2] https://www.unssc.org/sites/default/files/2030_agenda_for_sustainable_development_-_primer_russian.pdf (Date of access: 01.08.2022).

[3] https://www.spglobal.com/ratings/en/research/articles/220303-ratings-actions-waypoint-the-russia-ukraine-conflict-12299837 (Date of access: 01.08.2022).

[4] https://www.moodys.com/research/Moodys-withdraws-credit-ratings-on-multiple-entities--PR_464393 (Date of access: 01.08.2022).

[5] Our Common Future. World Commission on Environment and Development Report. Oxford University Press, 1987. 383 p.

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A definition of sustainable development that is closer to the original interpretation given in the late 1980s is as follows: it is a balanced development that ensures the progress of economy and society and does not damage the natural environment (Inshakova, 2004). Later studies give similar interpretations: sustainable development is a qualitatively new stage in the evolution of environmental and economic relations aimed at building a harmonious society capable of providing a balanced interaction of economic, social, and environmental factors of development (Nurtdinov et al., 2012).

In contrast to sustainable development, resilience described as the ability of territorial systems to maintain the constancy and balance of internal parameters under the influence of internal and external shocks is used for short-term effects (Klimanov et al., 2018).

After 1992, the conflict of interests between economy, society and the environment became increasingly evident. There was a need to introduce the concept of joint management of global stakeholders[6]. In 2012, another UN conference on sustainable development called Rio + 20 was held, which showed that a green economy is the key to resolving conflicts between development and the environment (Barbier, 2012). By the end of the summit, one more component was added to the concept of sustainable development – management (Zhu, 2016). In other words, the need was recognized to ensure "sustainable management of natural resources and ecosystems, which are consistent, inter alia, with the goals of economic, social, and human development, and at the same time contribute to the conservation of ecosystems, their regeneration and restoration and increase their resilience in the face of new and future challenges"[7].

The long-term guidelines in the field of sustainable development which are still followed in the world today were formulated within the framework of the UN Summit on Sustainable Development held in 2015 in New York. The declaration "Transforming Our World: The 2030 Agenda for Sustainable Development" identified seventeen goals and 169 targets[8] set for all countries.

Recently, a trend in Russia and for the world in general has been the increasing importance of financial flows in the public sector for the development of territories (Pasyankov, 2020), although sustainable development in Eastern and Western European countries is affected by various economic, social and environmental processes (Lopatkova, 2021).

Within the economic research policies, governmental debt is a factor in policy development. This affects policies connected to sustainability, which can be presented in different forms:

– as part of the theory of public finance (Shah et al., 2009; Musgrave, 1973);

– as a direction and instrument of a budgetary policy, including, among other things, the need to ensure a balanced budget (Kudrin, Deryugin, 2018; Lavrov, 2019; Mikhaylova, Timushev, 2022);

– as part of strategic planning at various levels of government (Klimanov, Kazakova, 2022; Zhikharevich et al., 2021; Wolfe, 2010);

– as a mechanism for the implementation of policies pursued by subnational authorities and local governments (Zubarevich, 2020; Biermann et al., 2014; Hassink, 2010).

As the government's opportunities for borrowing are declining, leading to a higher risk of default on debt obligations, the question of debt sustainability is gaining urgency. During economic downturns, government borrowing is becoming particularly important and a decrease in the government's capacity for borrowing reduces the overall potential for a counter-cyclical fiscal policy. Thus, a balanced policy of debt borrowing at the subnational level is important for sustainable regional development.

However, only a few studies have been devoted to the analysis of the creditworthiness of subnational territorial units. One of the first studies (Laulajainen, 1999) analyzing the ratings of Russian regions notes the low variability of the credit ratings of German states compared to the ratings of US states. Several papers reveal the factors leading to the variable credit ratings of regions, including the system of intergovernmental relations and the level of budgetary independence, among others (Beck et al., 2017; Baskaran, 2012). In one

[6] United Nations (2012). The Future We Want. Resolution adopted by the General Assembly on 27 July 2012. Available from: https://www.eea.europa.eu/policy-documents/the-future-we-want-2013declaration (Date of access: 01.08.2022).

[7] United Nations (2012). The Future we Want. Resolution adopted by the General Assembly on 27 July 2012. Available from: https://www.eea.europa.eu/policy-documents/the-future-we-want-2013declaration (Date of access: 01.08.2022).

[8] United Nations (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. Available from: https://www.unssc.org/sites/default/files/2030_agenda_for_sustainable_development_-_primer_russian.pdf (Date of access: 01.08.2022).

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of the latest studies, Mikhaylova and Timushev (2022) concluded that the lower creditworthiness of Russian regions from an international perspective reflects the weakness of the institutions of the Russian budgetary system, in particular, the insufficient tax and expenditure autonomy of local and regional authorities. Some works show that poorer and less fiscally independent regions have a lower access to budget credits and are forced to rely on more expensive market debt instruments (Johnson, Yushkov, 2022).

In view of the changes in the budgetary legislation, it is expected that the volume of the public debt of Russian regions will increase while its structure will be changing. The COVID-19 crisis led the federal government to test new forms of support for regions. In the same period, new instruments of debt policy such as infrastructure loans were introduced. These instruments, especially green financing and green bonds, require additional research and assessment of their potential (Bhattacharyya, 2022; Ilic, 2019; Bogacheva, Smorodinov, 2018).

Method and Data

In this paper we consider the information on Russian regional budgets and their public debt. We analyze credit ratings, indicators of debt sustainability, and regional data. The data are obtained from the websites of Russia's Ministry of Finance, the Treasury, and independent rating agencies.

The analysis uses credit ratings data for the beginning of 2022 assigned by such international agencies as Fitch, Standard & Poor's, and Moody's[9].

The methods of comparative and retrospective analysis are used to identify the state and features of regional debt policies.

Using data from the Russian Ministry of Finance for a 17-year period (2005–2021), we show the size of the regional budget deficit in Russia. Then we consider in detail the structure of debt obligations of the regions. We have collected data from rating agencies on regional ratings. The data for the period since 1997 taken from *Rusbonds.ru* are used for a comparative analysis of the number and volumes of issuance of regional bonds. The results of our analysis will be used to draw conclusions about the practice of using bonds in Russian regions.

[9] https://www.spglobal.com/ratings/ru/index; https://www.fitchratings.com; https://www.moodys.com/researchandratings/region/europe/-/004001001/005007?tb=2 (Date of access: 01.08.2022).

Results

In this section we review the practices of green bonds usage in Russia and the city of Moscow in particular. We analyze the data on the public debt and budgets of Russian regions as well as their credit ratings and conduct a retrospective analysis of regional bond issuance practices.

Green bonds in Russia

Green bonds form a group of responsible investment bonds and represent one of the promising financial instruments for raising the necessary funds for the implementation of the environmental policy, urban infrastructure development and social issues.

However, this tool has not yet taken its rightful place in the arsenal of regional financial structures in Russia. Currently, green bonds are issued by commercial and state-owned companies.

The key problem of the placement of green bonds by the regions remains the principles of the unity of the cash desk and the general coverage of budget expenditures of the Budget Code of the Russian Federation. Possible ways to address the issuance of green bonds within the current legislation include the following:

– issue of securities by companies with state participation in the format, for example, of regional development corporations, regional funds for supporting SMEs;

– allocation to eligible projects of the equivalent value of budgeted funds;

– issue of project financing bonds for regional projects in the form of, for example, PPP projects.

To finance projects in the field of environmental protection and socially significant projects, the Moscow Exchange created a sustainable development sector, which consists of: 1) green bonds, 2) social bonds, and 3) the bonds that correspond to the goals and objectives of national projects.

In May 2021, the Bank of Russia registered program DOM.RF. The Bank plans to issue infrastructure bonds in the amount of 300 billion rubles in 2022–2023. The funds raised this way will be spent on the construction of roads, engineering and social infrastructure for housing construction projects and urban infrastructure within the framework of the "Housing and Urban Environment" national project.

In addition, in his Address to the Federal Assembly of April 21, 2021, the President announced the government's intention to implement a new development tool – infrastructure

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budget loans. A previously used debt policy instrument, infrastructure bonds are bonds issued to raise financing for long-term infrastructure development projects. The new mechanism – infrastructure budget loans – will be issued to the regions from the federal budget at a rate of no more than three percent per annum and with a maturity of 15 years. Until the end of 2023, it is planned to allocate such infrastructure loans for a total amount of at least 500 billion rubles[10]. The general principle of distribution of infrastructure loans is as follows: the less debt a region has, the more it will be able to receive infrastructure loans. The first such loans are planned to be issued to the Yamal-Nenets Autonomous District Krasnoyarsk, Nizhny Novgorod, and Chelyabinsk regions.

Thus, there are obvious prerequisites for further development of green bonds and other tools of responsible financing.

Budgetary and debt situation in Russian regions

In Russia, like in other countries of the world, in addition to the budget of the central government, regions and municipalities also form budgets at their respective levels. The country's budgetary system consists of the federal budget, the budgets of state social service funds, and budgets of regions and municipalities. The budgetary system is based on general economic relations and the state structure and is regulated by the federal legislation. The sum of consolidated budgets of Russian regions is understood as a set of regional and local budgets without taking into account intergovernmental fiscal transfers between them. It should be noted that the share of the latter in the Russian budget system is relatively small and has been declining in recent years.

It can be noted that over the past 15 years, consolidated budgets have been executed with an overall surplus only a few times: in 2006–2007 and in 2018–2019 (Fig. 1). In 2019, however, this surplus was insignificant.

Over the period indicated above, the structure of revenues of the consolidated regional budgets has transformed. The general trend is to increase the share of intergovernmental fiscal transfers and reduce the share of income tax in the structure of regional budget revenues. The situation in 2020 was not quite typical because, for the first time in 15 years, transfers exceeded income tax receipts.

In general, the personal income tax has been the main source of income for the consolidated regional budgets since 2009. For the last three years, it has accounted for 29 per cent of the revenues.

[10] Address from the President to the Federal Assembly. http://www.kremlin.ru/events/president/news/65418 (Date of access: 01.08.2022).

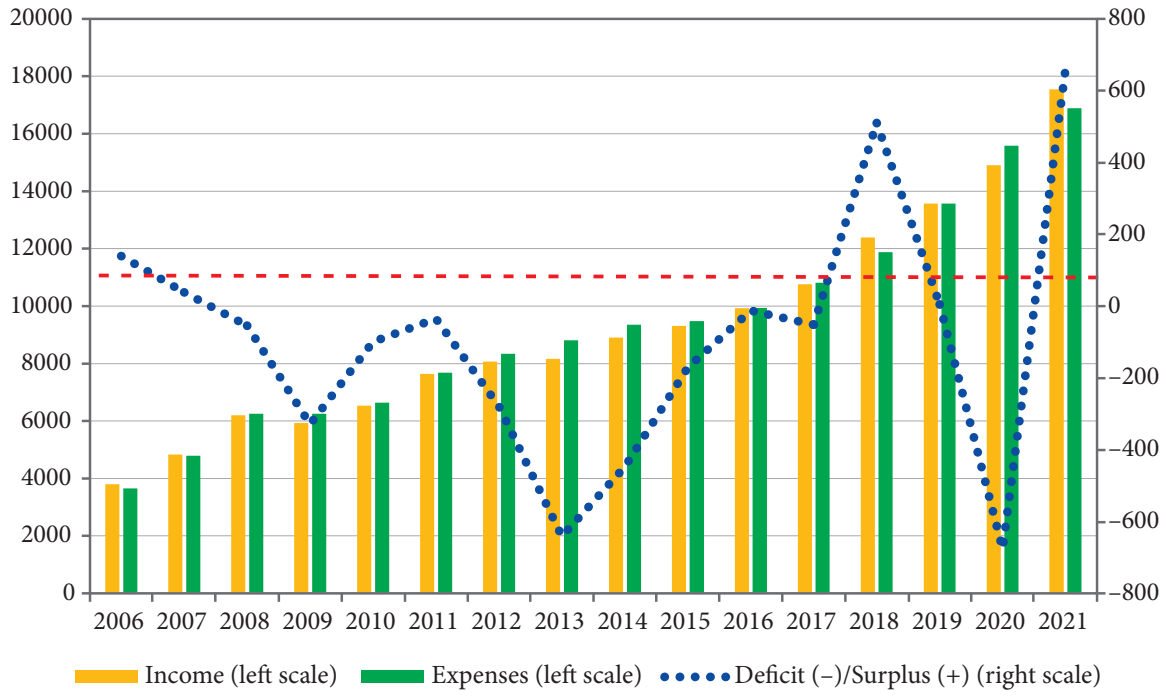

Figure 1. *Balance of regional budgets in Russia, billion rubles*

Source: compiled by the authors based on the data from the Ministry of Finance of Russia

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Regional disparities in the tax base are huge in Russia. For example, 10 regions account for 56 per cent of all the revenues from the personal income tax, while 60 per cent of the corporate income tax is derived from only 10 regions.

Moscow is the most financially stable region in Russia; the revenue base is almost totally derived from its own sources.

Some of the federal budget's funds are distributed among the regions in the form of intergovernmental fiscal transfers (not linked to the purposes of granting – dotations, conditioned by the specific purposes of granting – subventions, subsidies, and other transfers) aimed at equalizing the vertical imbalance in the distribution of taxes.

The share of these transfers in the structure of regional budget revenues was declining from 2009 to 2017. After that, it began to grow again, amounting to a quarter of the revenues of the consolidated regional budgets in 2020. Previously, the same indicator level was observed in the crisis year of 2009. In addition, 2020 was characterized by the largest volume of budget loans issued in 15 years.

It can be noted that in the last five years there has not been such a rapid growth in budget loans, as it was, for example, in 2012–2016. In 2018 and 2019 their volumes even decreased.

Since 2016, however, budget loans have become the main element in the structure of the state debt of regional budgets (Fig. 2). In 2020, the share of such loans in the structure of regional debt exceeded the share of bank loans by almost two times. Government securities of the regions were the main element of the regional debt structure from 2005 to 2010. From 2013 to 2015, the main share in the loan portfolio of the regions was given to loans from credit institutions. Only in 2019, for the first time since 2011, the share of government securities in the structure of regional borrowings exceeded the share of bank loans. In 2020, this trend strengthened.

A potential incentive for further growth in the regional bond market may be the fact that since 2020, the annual repayment and debt service volumes have been used to assess debt sustainability. Therefore, replacing bank loans with bonds, the maturities of which are usually longer, will help reduce such payments.

Credit ratings of Russian regions

In general, if a region wants to enter the debt market, it must comply with certain conditions specified in the law. The issue of securities of a region is also subject to certain restrictions.

An important indicator of debt sustainability is the borrower's creditworthiness, which can be confirmed by a credit rating. An issuer's credit rating is an informed third-party opinion on creditworthiness (the risk of default). Ratings increase the availability of information and, as a result, high credit ratings increase the liquidity of the issuer in the debt market. Along with the credit rating, the liquidity of bonds is influenced by such factors as the issue volume, volatility, publicity of the issuer, etc.

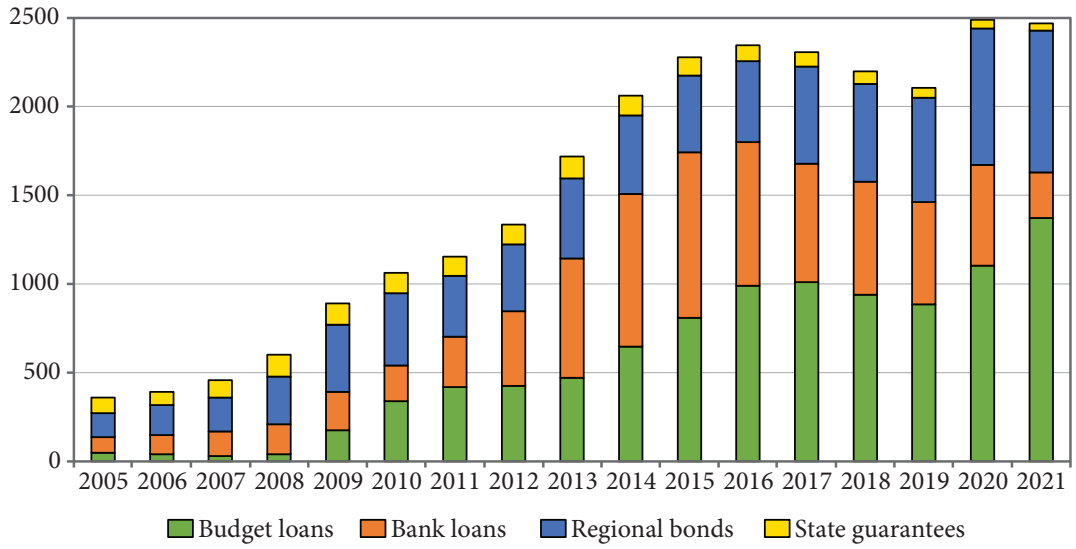

Figure 2. *Volume and structure of public debt of regions, billion rubles, by the end of the year*

Source: compiled by the authors based on the data from the Ministry of Finance of Russia

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The sovereign rating of Russia had remained at a very low level even before March 2022. Major international rating agencies such as *Fitch, Standard & Poor's (S&P)* and *Moody's* have assigned Russia BBB, BBB–, and Baa3 ratings accordingly.

Russian regions are rated by the Russian ACRA and Expert RA agencies. As of May 2021, 52 regions have at least one assigned credit rating from a Russian rating agency. At the same time, Krasnodar region, the Republic of Tatarstan, the Yamal-Nenets Autonomous District, and Tomsk region have up-to-date ratings from both agencies.

The peculiarity of regional ratings is that, according to the methodology, they cannot be higher than the country's sovereign ratings. Table 1 presents the credit ratings of the Russian regions from the largest international rating agencies.

At least 27 Russian regions have an up-to-date credit rating assigned by an international agency. At the same time, only the City of Moscow and Krasnoyarsk region have ratings from three agencies.

Fitch estimates that six Russian regions, including the City of Moscow, have their own credit ratings above the sovereign. These include Chelyabinsk Region, the City of St. Petersburg, the Yamal-Nenets Autonomous District, Bashkortostan and Tatarstan. However, according to the rules of the methodology, their final ratings are on a par

Table 1

Credit Ratings of Russian Regions in February 2022

Region	Fitch	S&P	Moody's
Central Macroregion			
Lipetsk Region	BB+	–	–
Moscow Region	BBB–	–	Ba1
Smolensk Region	B+	–	–
Yaroslavl Region	BB	–	–
City of Moscow	BBB	BBB-	Baa3
Northwestern Macroregion			
Komi Republic		–	Ba3
Leningrad Region		BB+	–
City of St. Petersburg	BBB	–	Baa3
Southern Macroregion			
Krasnodar Territory			Ba3
North Caucasian Macroregion			
Stavropol Territory	BB+	–	–
Volga Macroregion			
Republic of Bashkortostan	BBB	–	Ba1
Mari El Republic	BB	–	–
Republic of Tatarstan	BBB	–	Ba1
Chuvash Republic	–	–	Ba2
Kirov Region	BB–	–	–
Nizhny Novgorod Region	BB	–	Ba3
Orenburg Region	BB+	–	–
Samara Region	–	BB+	Ba2
Ural Macroregion			
Sverdlovsk Region	BB+	–	–
Khanty-Mansi Autonomous District	–		Ba1
Yamal-Nenets Autonomous District	BBB	BBB–	–
Chelyabinsk Region	BBB	–	–
Siberian Macroregion			
Altai Territory	BBB-	–	–
Krasnoyarsk Territory	BB+	BB	Ba3
Novosibirsk Region	BBB-	–	–
Omsk Region	–	–	Ba3
Far Eastern Macroregion			
The Republic of Sakha (Yakutia)	BBB–		–
Number of rated regions	20	5	13

Source: compiled by the authors based on the data from Fitch, Standard & Poor's, Moody's Ratings.

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with Russia's sovereign rating (BBB). Smolensk (B+), Yaroslavl (BB) and the Republic of Mari El (BB) have the lowest ratings, according to *Fitch* methodology.

Among the issuers assessed by *Moody's*, the City of Moscow and the City of St. Petersburg have the highest credit ratings corresponding to Russia's sovereign rating (Baa3), and only they fall into the "investment grade".

Bond-related practices of Russian regions

The experience of regional governments in attracting borrowed funds through the issuance of securities is diverse. Table 2 summarizes the information on bond practices since 1997. In general, almost all the regions have resorted to issuing bonds, but the table shows only the regions for which relevant open data are available.

It is noteworthy that in addition to the cities of Moscow and St. Petersburg, several Russian regions are actively resorting to the issuance of securities. For example, since 1997, Tomsk Region has had 52 bond issues. In addition, in 2020, Tomsk Region was the first in Russia to launch an online sale of bonds for the public on the marketplace platform, which made them available to citizens of the Russian Federation.

The Republic of Sakha (Yakutia), Nizhny Novgorod, Krasnoyarsk, and Sverdlovsk regions also have a long experience of issuing government securities. For the first time, Yakutia issued government bonds in 1995, simultaneously with Moscow and St. Petersburg. All bond issues of Yakutia are included in the top-level quotation list of the Moscow Stock Exchange.

Bond placement by Russian regions takes place mainly in the fourth quarter. Over the past five years, in the first quarter, the regions did not issue bonds at all.

In general, debt management is the process of developing and implementing a set of measures aimed at attracting borrowed resources necessary for the development of the region, while maintaining acceptable risk levels and borrowing costs.

In 2020, 18 Russian regions issued bonds (21 per cent of the total number of regions). The leaders in 2020 were Moscow Region (285.1 billion rubles) and Sverdlovsk Region (113.4 billion rubles), which accounted for 19.7 per cent of all attracted funds.

If we consider the placement of securities on the stock market, then for the period from 2006 to the 2nd quarter of 2021, the number of issues of regional bonds in circulation is 120 units for the total amount of 947.7 billion rubles[11]. The period from 2018 to the 2nd quarter of 2021 accounted for the largest share of bond issues (60.7 per cent), in which 2020 alone accounts for 34.3 per cent. The average coupon rate was 7.97 per cent, and the average maturity was 6.5 years.

The most active placements were carried out by 4 regions: Sverdlovsk Region (9 placements for 73 billion rubles), the Republic of Sakha (Yakutia) (8 and 39,450 million), Belgorod Region (8 and 18,785 million), and Moscow Region (7 and 162 billion). In general, this group of regions accounted for 26.7 per cent of the total number of placements and 30.9 per cent of the total volume of attraction. The second group of active regions (Yaroslavl, Samara, Novosibirsk, Nizhny Novgorod, Krasnoyarsk, and the City of St. Petersburg) placed four or five issues each and accounted for 24.2 per cent of all the placements and 29.9 per cent of the total volume. Other regions placed from one to three issues.

Our analysis of placement volumes showed that there are three leaders among the Russian regions, that is, those that have attracted more than 100 billion rubles: Moscow Region (162 billion rubles), the City of St. Petersburg (115 billion rubles), and the City of Moscow (100 billion rubles). They have accounted for about 40 per cent of the total placement volume over the past 14 years. The second place is occupied by two other active market players (with the volume of attraction from 50 billion to 100 billion rubles): Sverdlovsk (73 billion rubles) and Krasnoyarsk (55.47 billion rubles), which account for 13.6 per cent of the total placement. Together, these two groups make up 53.3 per cent of the total placement volume.

Moscow as the largest borrower

The City of Moscow, the largest city in the country, has accumulated sufficient experience in pursuing debt policy at the sub-federal level.

Until the spring of 2021, the last time Moscow entered the market was in 2013. In the spring of 2021, the bond issuance policy became active again. At that time, three bond issues (72nd, 73rd and 74th) took place. These amounted to 70 billion rubles each[12].

[11] According to the data of the Moscow Stock Exchange. https://www.moex.com/en (Date of access: 01.08.2022).

[12] Tkachev, I., Khazarnovsky, P. City authorities borrowed to travel. https://www.rbc.ru/newspaper/2021/04/28/6087c7b99a7947ddd61c3894 (Date of access: 01.08.2022).

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Table 2

Bonds of Russian regions in 1997–2021

Region	Number of bond issues	Total amount, bln rbs	Average yield for the entire issue period, per cent
Belgorod Region	19	45.7	9.6
Voronezh Region	4	18	9.7
Kostroma Region	3	11	9.9
Lipetsk Region	7	20	8.4
Moscow Region	7	177	7.08
Smolensk Region	1	3	9.2
Tambov Region	3	8.1	8.5
Yaroslavl Region	18	58	9.3
City of Moscow	82	1,034.5	11.7
Republic of Karelia	18	18.03	11.6
Komi Republic	14	45.23	14.7
Vologda Region	6	7.4	11.7
Leningrad Region	2	9.2	13.5
Murmansk Region	2	0.55	16.8
City of St. Petersburg	34	390	14.8
Nenets Autonomous District	1	2	8.03
Krasnodar Territory	8	53.3	14.2
Volgograd Region	15	37.7	9.6
Karachay-Cherkessia Republic	1	2	8.99
Stavropol Territory	5	34.8	8.8
Republic of Bashkortostan	10	22.5	12.3
Mari El Republic	5	6.2	10
The Republic of Mordovia	3	11	12.1
Udmurt Republic	10	31	9.7
Kirov Region	1	5	8.77
Nizhny Novgorod Region	15	105.5	9.7
Orenburg Region	2	9	9.4
Penza Region	2	1.8	9.9
Saratov Region	1	5	8.35
Sverdlovsk Region	11	81	7.6
Chelyabinsk Region	3	23	6.14
Yamal-Nenets Autonomous District	2	21.8	9.85
Republic of Khakassia	6	15.7	10.8
Krasnoyarsk Territory	13	142	9.8
Irkutsk Region	20	16	12.1
Kemerovo Region	2	10	8.45
Novosibirsk Region	3	6	12.3
Omsk Region	4	20	9.3
Tomsk Region	52	67	12
Republic of Sakha (Yakutia)	22	77.3	10.5
Kamchatka Territory	1	1	9.36
Magadan Region	2	2	12.05

Source: compiled by the authors based on rusbonds.ru data

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The funds raised through the placement of bonds of the 72nd and 73rd issues are planned to be used to finance the most important urban infrastructure projects, including the transport, energy-saving, and engineering sectors. It is more profitable for the city to borrow funds and create infrastructure today than to build it in a few years by using its own sources of funds. According to the Moscow Department of Finance, the implementation of projects to deve-lop urban infrastructure will support the level of economic activity and employment and will have a positive impact on the dynamics of budget revenues.

The 74th bond issue was carried out for the first time in the country in accordance with the concept of green bonds, approved by the order of the Moscow City Government. The issue will comply with the Green Bond Principles of the International Capital Market Association (ICMA), as well as the guidelines for the development of investment activities in green financing in the Russian Federation developed by VEB.RF.

The International Capital Markets Association (ICMA) confirmed the compliance of the 74th issue with the UN principles of sustainable development and included the securities in the relevant register.

The Moscow Government plans to use the equivalent of the funds received from the placement of green bonds to finance and refinance urban environmental projects to reduce pollutant and greenhouse gas emissions from motor vehicles. These funds will finance, for example, the replacement of the Moscow bus fleet with electric buses.

Moreover, the funds raised are planned to be used to finance the construction of 18 stations and 43.8 kilometers of lines, as well as the reconstruction of three stations and 4 km of lines of the Big Circle Line. Thanks to the opening of traffic on these sections of the Big Circle Line in 2023, at least 10,000 cars will no longer drive onto the streets of the city every day, which will lead to a reduction in pollutant emissions by 885.5 tons per year, and carbon dioxide by 20,900 tons per year. The project for the construction of lines and stations of the Big Circle Line includes measures aimed at reducing the negative impact on the environment, e.g. promoting a responsible attitude to the purity of atmospheric air, reduction of noise impact and other physical factors, protection of groundwater, as well as recycling of waste generated during construction[13].

[13] Proceeds from green bonds will be used to finance urban eco-projects. https://www.mos.ru/mayor/themes/7299/7288050 (Date of access: 01.08.2022).

Conclusions

The study revealed the increasing role of budget loans in the structure of public debt of Russian regions in recent years. They are an element of a pro-cyclical budget policy and do not contribute to the budgetary sustainability and independence of the regions, which is an obstacle to the use of green bonds as a tool of responsible financing.

However, in 2021 Moscow issued green bonds and thus became a pilot case among the Russian regions[14]. Formally, the purpose of this measure is to raise borrowed funds to finance the budget deficit or repay the previous debt obligations (bond loans, loans, etc.). This is determined by the requirements of the budget legislation, including the principles of the unity of the cash desk and the cumulative coverage of budget expenditures. Thus, all budget revenues are credited to a single budget account and budget expenditures cannot be linked to specific budget revenues and sources of financing the budget deficit.

The implementation of the 74th bond issue of Moscow in the amount of 70.0 billion rubles qualifies as an issue of green bonds aimed at reducing pollutants and greenhouse gas emissions from motor vehicles. Thus, the City of Moscow fits into the general global trend of territorial development and tackles social issues through active placement of ESG and green bonds.

Our analysis of regional practices in attracting borrowed funds through the issuance of securities revealed that, even though green bonds appeared only in Moscow, other tools of responsible financing are actively being developed. This means that in today's Russia the ESG agenda is popular.

Now it is impossible to say with absolute certainty what the future of the ESG segment of regional borrowings in Russia will be like, but most experts agree that, despite the sanctions, this vector of development will not be changed[15]. Thus, the priorities stay the same, and the ESG agenda remains extremely relevant for Russian companies, regions, and cities.

[14] https://budget.mos.ru/budget/debt/bonds (Date of access: 01.08.2022).

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FDI outflows and international trade nexus: Empirical evidence from country income groups

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ABSTRACT
Relevance. Outward foreign direct investment (OFDI) and international trade are traditionally viewed as key drive of economic integration and globalization. At the same time, the relationship between these phenomena is ambiguous both from theoretical and empirical points of view. This study contributes to the existing literature by analyzing the relationship between outward foreign direct investment and international trade for countries with different levels of income per capita.
Research objective. This study examines the dynamic interplay between OFDI and international trade in different income groups such as low-income (LIC), low-middle income (LMIC), upper-middle income (UMIC), and high-income (HIC) groups.
Data and methods. Based on World bank country income classifications, data from 161 countries are divided into LIC, LMIC, UMIC, and HIC for the period 1998-2019. The study employs the Difference (DFF-GMM) and two-step System Generalized Method of Moments (SYS-GMM) techniques to explore the OFDI-trade nexus.
Results. The results are mixed and significant providing support for both complementarity and substitutive FDI. Findings suggest that OFDI and trade nexus in LIC have negative impact indicating a substitutive effect, but in other economies, the impact is significantly positive and complementary.
Conclusions. Trade and OFDI nexus are substitutive in LIC, hence sound economic policy, aimed at increasing country's international competitiveness, should be adopted. However, trade and OFDI in LMIC, UMIC and HIC economies have mutually complementary relationship that facilitates the improvement of the domestic economy. Thus, government should promote policies that sustain the benefits of OFDI and trade interactions.

KEYWORDS
outward FDI, trade, exports, imports, system GMM, country income groups

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Взаимосвязь оттоков прямых иностранных инвестиций и международной торговли: эмпирический анализ для стран с разным уровнем дохода

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АННОТАЦИЯ
Актуальность. Прямые иностранные инвестиции (ПИИ) за рубеж и международная торговля традиционно рассматриваются как ключевой двигатель экономической интеграции и глобализации. В то же время взаимосвязь между данными явлениями неоднозначна, как с теоретической точки зрения, так и с точки зрения результатов известных эмпирических работ. Данное исследование вносит вклад в имеющуюся литературу, анализируя характер взаимозависимости между данными явлениями для стран с разными уровнем дохода на душу населения.

КЛЮЧЕВЫЕ СЛОВА
оттоки прямых иностранных инвестиций, международная торговля, экспорт, импорт, обобщенный метод моментов, взаимосвязь торговли и инвестиций

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Цель исследования. В исследовании изучается динамическое взаимодействие между оттоками ПИИ и международной торговлей в группах стран с разным уровнем дохода: низким доходом, ниже среднего, выше среднего и высоким доходом.
Данные и методы. Использованы данные по 161 стране за период 1998–2019 годы. Страны разделены по уровню дохода в соответствии с подходом Всемирного Банка. Для изучения динамической взаимосвязи ПИИ и торговли в исследовании используются разностный обобщенный метод моментов (DFF-GMM) и двухшаговый системный обобщенный метод моментов (SYS-GMM).
Результаты. Результаты статистически значимы, но неоднозначны, поскольку выявляют как эффекты замещения, так и эффекты дополнения между международной торговлей и исходящими прямыми иностранными инвестициями. Исходящие ПИИ и международная торговля замещают друг друга в странах с низким уровнем дохода, в то время как в других группах стран их взаимовлияние является взаимодополняющим.
Выводы. Связь между торговлей и исходящими ПИИ является замещающей в станах с низким доходом, поэтому для развития экономики им следует экономическую политику, направленную на повышение конкурентоспособности на мировом уровне. В то же время торговля и исходящие ПИИ в странах со средним и высоким доходом дополняют друг друга, что способствует росту национальной экономики. Таким образом, правительству следует продвигать политику, поддерживающую экспансию национальных компаний и развитие международных торговых связей.

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外国直接投资流出与国际贸易的关系：对不同收入水平国家的实证分析

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摘要
现实性：外国直接投资（FDI）和国际贸易历来被视为经济一体化和全球化的主要推动力。同时，无论是从理论上还是从已知经验工作的结果来看，这些现象之间的关系都是模糊的。本研究通过分析不同人均收入水平国家这些现象之间的关系，并为现有文献做出贡献。
研究目标：该研究考察了不同收入水平国家（低收入、中下收入、中上收入和高收入）的外国直接投资流出和国际贸易之间的动态互动。
数据与方法：本文使用了161个国家在1998–2019年期间的数据，并按照世界银行国家收入水平来划分类别。本研究采用差分广义矩量法（DFF-GMM）和系统广义矩量法（SYS-GMM）来研究外国直接投资和贸易之间的动态关系。
研究结果：结果在统计学上是显著的，但也是混合的，因为它们显示了国际贸易和对外直接投资之间的替代和互补效应。在低收入国家，外向型外国直接投资和国际贸易相互替代，而在其他国家集团，它们是互补的。
结论：贸易与对外直接投资之间的联系在低收入国家是一种替代关系，所以他们应该采取经济政策，成为具有全球竞争力的国家，以发展其经济。同时，中高收入国家的贸易和对外直接投资相辅相成，促进了国民经济的增长。因此，政府应支持本国公司扩张和发展国际贸易联系。

关键词
外国直接投资流出、国际贸易、出口、进口、广义矩量法、贸易投资关系

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1. Introduction

Since the end of the 1980s, the patterns of trade have continued to change, reflecting the gradual integration of domestic economies into global production chains (Osabuohien-Irabor & Drapkin, 2021; Brana, 2016; Fontagné & Pajot, 1997). These advancements have been made possible by rapid development of information and communication technologies as well as the liberalization of trade and investments. Thus, trade and foreign direct investments (FDI) remain two key drivers of global economy, facilitating cross-border investment as well as goods and services around the world. According to the United

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Nations Conference on Trade and Development (UNCTAD, 2020), global OFDI declined by 38.4 per cent from US$ 1601 billion in 2017 to reached US$966 billion in 2018 and rose by 33 per cent to US$1314 billion in 2019. Compared to 2019, these flows declined by 49 per cent in 2020 due to economic crisis caused by COVID-19 global pandemic (UNCTAD, 2021). More so, international trade in goods and service reached US$21 trillion in 2016 from US$18 trillion in 2014. Then rose by 7 and 10 per cent in 2017 and 2018 to US$22.5 trillion and US$24.9 trillion respectively. However, to what extent are these increases and decreases in trade and OFDI linked in different income economies? To this end, this study seeks to empirically examine whether the relationship between home country international trade and OFDI are complementary or substitutive across different income economies groups.

In the last four decades, there has been a substantial debate on whether the relationship between international trade and OFDI is complementary or substitutive. Many empirical studies have examined this relationship in different strand of literatures using single country analysis (Rehman & Noman, 2021; Greaney & Kiyota, 2020; Tham et al., 2018; Chiappini 2016), group analysis for developed and developing countries (Sabir et al., 2019), as well as literature examining FDI inflow in country income (Joshua et al., 2020; Araujo et al., 2017; Huang et al., 2016). This has led to inconclusive results in large numbers of empirical studies. However, analysis based on OFDI and trade relationship from developing economies have increased faster than those from developed countries (Herzer, 2011). Whilst considerable numbers of studies indicated that OFDI-trade nexus are positively related indicating a complementarity relationship which supports complementarity effects (Albulescu & Goyeau, 2019; Ahmad et al., 2016), other studies suggested negative relationship which may lead to substitutive effects underpinning the horizontal FDI theory (Anderson et al., 2019; Mitze et al., 2010). Many other studies such as Ahmad et al (2016); Goh et al. (2013) have also found evidence of mixed results for OFDI and international trade relationship.

However, the interactions of international trade and OFDI may reduce domestic production cost as well as raise return for domestic production (Ali et al., 2021; Liu et al., 2016). For this reason, MNEs may merge home country and foreign productions to stimulate home country's output and facilitate investment inflows. Domestic productions are stimulated by allowing the domestic firm to start new international market using MNEs imported primary products from the host country to produce higher volume of goods at lower prices at home country or other affiliates. Overseas direct investment and international trade may also promote the transfer of technology from host or affiliates to home country and facilitates production process which improves the economy (Osabuohien-Irabor & Drapkin, 2022). Notwithstanding the spillover effects of OFDI and trade to home economies, policy makers are worried that outward-internationalization activities may lead to 'hollowing-out' effects giving rise to de-industrialization and jobs losses (Liu et al., 2015; Yamashita, & Fukao, 2010) as well as crowd out investment from domestic economy. Trade liberalization lowers the cost of transactions and allows FDI to 'sidestep' the tariff barriers. Most empirical studies of OFDI-trade in developing economies mainly comes from Brazil, India and China, where the results show complementarity effects (Gusarova, 2019; Knoerich, 2017).

The World Bank introduced the per capita income thresholds which examines the relationship between measures of well-being and GNI per capita for different income groups, and these include LIC, LMIC, UMIC, and HIC groups. Based on 2019 purchasing power parity (PPP), a country is LIC if its GNI per capita is below $1,026; LMIC between $1,026 and $3,995; UMIC between $3,995 and $12,375; and HIC above $12,375. Fig. 1 shows OFDI and trade series in different income groups, for instance, LIC shows upward trend which peaked in 2011, decreases and have moved upward since 2015. In plot (b), LMIC group show no trend between 1970 and 2003, as the values of OFDI and trade did not make much significant difference during this period. OFDI had sharp increase in 2005 and peaked in 2008 followed by a sharp downward trend till 2015 and then continued with a slow undulating upward trend, trade continue to maintain steady upward movement from the year 2003 and decrease in 2018. Similarly, plots (c) and (d) shows OFDI and trade relationships in UMIC and HIC economies. For the former, both series moved together without trend between 1970 to 2000, then had a sharp upward trend from 2003 to 2017, afterward both series decreased together. However, unlike the series in plots (a), (b) and (c), plots (d) in HIC

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shows that since 1970 both the OFDI and trade series have continued to trend upward, peaked in 2007, then decreased. These plots suggest great differences in the macroeconomic factors among the different country income groups, which justifies the need to further examine the relationship empirically.

However, to the best of our knowledge, studies examining OFDI and international trade nexus in different income economies remain scanty and unexplored, as only few literatures concerning FDI inflow-trade relationship in developing economies exist. The dynamic feedback relationship between international trade and OFDI as well as the cross-country variation in investment and trade may lead to serious econometric problem such as simultaneity bias, serial correlation, reverse causality, endogeneity, heterogeneity, omitted variable bias, and bring about spurious regression with bias estimates. Thus, this study examines OFDI and trade relationship in different income economies classification such as HIC, UMIC, LMIC, and LIC using the two-step System Generalized Method of Moments techniques (SYS-GMM) developed by Arellano & Bover (1995) and Blundell & Bond (1998), and the Difference Generalized Method of Moments (DFF-GMM) estimator proposed by Arellano & Bond, (1991) which accounts for numerous econometric issues. This brings new insights to extant literature.

This study contributes to the existing literature in twofold. Firstly, to examine the dynamic interplay between OFDI and trade based on world bank country's income groups and to ascertain whether the pattern of the interrelationship is complementarity or substitutive. Secondly, to examines the effects of the global financial crisis (GFC) on MNEs outward internationalization activities as well as international trade in different income groups using the two-step SYS-GMM and the DFF-GMM techniques to estimate the investment and trade models. Finding reveals that the dynamic impact of the nexus between OFDI and international trade from countries with low wage are negative, however positive and significant impact was found in other economy clusters.

The rest of the paper is structured as follows: Section 2 presents the theoretical framework of FDI and trade theory as well as empirical reviews of related literature. Section 3 describes the study methodology and data employed in the study. Section 4 discusses, analyses, and interprets the estimated results. Section 6 briefly discusses the conclusion as well as the practical implication the study.

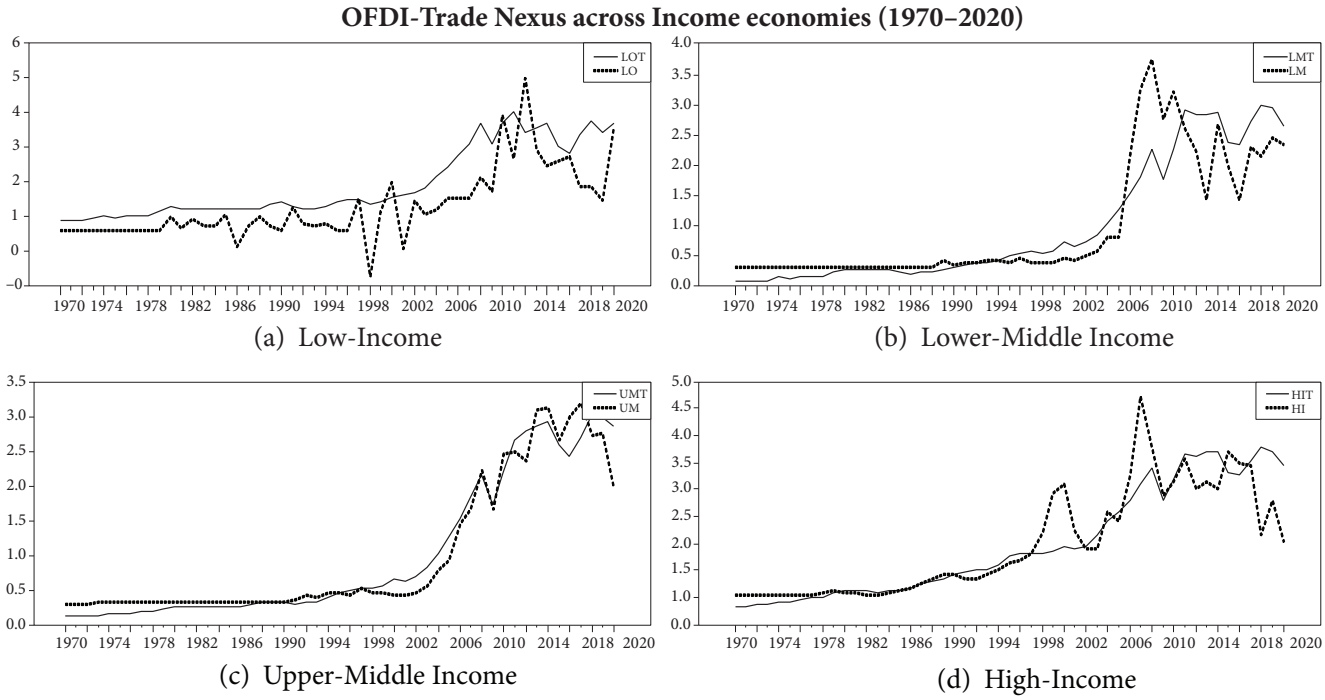

Figure 1. *Plots showing OFDI and international trade relationships in different income classifications such as high-income, upper-middle income, lower-middle income, and low-income economies*

Source: World Bank database (2020). https://data.worldbank.org/.
Author's evaluations (All plots are based on standardized values)

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2. Theoretical background and empirical literatures

The key effect of FDI flows is the impact on global trade, where the standard trade theory asserts that the relationship is substitute rather than complement. Mundell (1957) first expressed the entrance of capital inflows in the Heckscher-Ohlin (H-O) model framework. The model predicts that for direct movement of factors of production, trading in commodities are perfect substitutes, especially capital. Their key assumptions explained that the balance of commodity prices can be obtained via international factor mobility in the absence of trade in goods, otherwise the balance of the price factor can be generated from the sale of goods without the mobility of capital if the obstacles in trade are abolished. This implies that increase in trade impediment stimulates factor movements and that an increase in restrictions to factor movements stimulates trade, thus the substitution of commodity for factor movements will be complete.

However, in the real world, these assumptions are not always satisfied, so a model employing them is somewhat limited. Thus, some advanced theory was formulated which challenged the substitution result that the models formed by modification of standard assumptions of H-O model is more likely to give complementary results rather than substitutions between the factors of trade and trade in goods. Hence, removing barriers to factor movement bring about a complementarity effects under free trade, change in assumptions underlying the Heckscher-Ohlin model as well as identical factor endowments. This shows a feedback relationship which indicates that analysis in international trade may not be separated from other economic factors such as investment, during empirical analysis.

After the work of Mundell (1957), this debate on substitutive and complementarity relationship has led to many scholarly research papers. For instance, Dunning (1980) OLI paradigm framework view oversea production and trade (exports) as two alternative modes to compete in international markets. The Internalization theory which explains that if OFDI production fixed cost is higher due to higher transportation cost, then per unit costs of exports is higher. In order word, firms will prefer export if the cost of oversea production is high (Buckley & Casson, 1981). However, owing to nature of investments, knowledge-based assets transfer could give rise to substitutability between oversea production and exporting. This suggests that firms engage in the production of goods abroad to circumvent trade cost, thus a substitutionary relationship with market-seeking motive (Markusen, 1984).

Some other literatures postulated the proximity-concentration models where firms could either choose to produce abroad using an affiliate or export directly to host countries. But if they choose the latter rather than the former, they are bound to provide transport costs and tariffs. Therefore, if cost of transport and tariffs are high, firms will most likely prefer oversea production of goods ahead of direct exportation to compete in foreign market, leading to FDI-Trade (exports) substitutionary relationship (Brainard, 1997). To this end, Markusen (1984) and Brainard (1997) horizontal models, suggests that FDI-Trade (export) relationship may be substitutes if size, technological and factor endowments are similar between trading countries.

To get the best cost advantage from the most favorable locations, firms could engage in fragmentation of different stages of production at different location of resources endowments, leading to a complementarity relationship (Helpman & Krugman, 1985). This is also referred to as the factor proportion model, where the motives behind MNEs vertical FDI is the differences in factor cost. The vertical FDI framework will more likely happen between developing and developed countries. This suggests that whilst investment in developed (high industrialized) countries are merely to serve growing markets demands, investments in developing countries seek cheap and abundant resources, expectedly of vertical FDI. Even so, the sector (manufacturing, service, etc.) of oversea operation, the economy (developed or developing) as well as the type of industries (firm or plant level economies of scale) needs to be considered (Lipsey, 2002). Firm's expansion in international market can create increase in the demand for other product, as indication that at least two factors can explain the complementary (positive) relationship of vertical FDI theory (Head & Ries, 2004).

Few empirical studies have examined the nexus between OFDI and trade, and these literatures are taken at two different levels via; country levels (Anderson et al., 2019; Albulescu & Goyeau, 2019) and industry level (Borghesi et al., 2020; Chen & Fang, 2016). So far, not too few empirical stu-

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dies have examined the relationship between OFDI and exports (Li et al., 2020; Li, 2019; Bhasin & Paul, 2016), compares to handful studies on OFDI and imports relationship (Wu & Chen, 2021; Fan & Wang, 2020). The central focus of these studies is to examine whether the relationships are complementary or substitutive.

For studies examining OFDI and exports, finding shows that the effects of OFDI on China's export sophistication are strongly positive, varies across quantiles and region, and a significant driver of exports promotion (Li et al., 2020). For Chinese manufacturing firms' productivity, a complementarity effects between OFDI and export was found (Zhou, 2020). More so, investment abroad from BRICS countries for the period 1993–2015 showed to substitute exports, indicating that MNEs in these countries do not connect with their countries' firms (Bhasin & Kapoor, 2020). However, OFDI flows complements export sophistication (EXPY), as one per cent increase in OFDI leads to 0.1 per cent increase in EXPY (Li, 2019). Empirical analysis of the impact of OFDI flows on exports from Association of Southeast Asian Nations (ASEAN) found both complementarity and substitutive effects, but further results showed that the complementarity effects outweigh the substitution effects in four countries (Ahmad et al., 2016).

Similarly, MNEs in ten major emerging countries in Asia were found supporting home country firms, when a panel data for the period 1991–2012 were analyzed (Bhasin & Paul, 2016), but the results for sectoral level analysis of the impact of Italian stocks OFDI on trade (exports) suggests not to support a substitutionary relationship (Ferragina & Colacurcio, 2015). Regarding OFDI and imports nexus, empirical literatures have showed that OFDI via backward vertical integration, may give rise to imports and in turn boost the economic activities of home country. Wu & Chen (2021) study employed the SYS-GMM estimator to investigate the impact of the Chinese OFDI flows on trade (imports) intensity. Results revealed positive significant impacts which indicates complementary effects. Empirical research also showed that home country's imports, may promote the flow of investment abroad (Fan & Wang, 2020).

Based on the theoretical framework and literatures regarding international trade and OFDI relationship, potential feedback relationship between the two macroeconomic factors may lead to problem of reverse causality and simultaneity which occur when two variables affect each other simultaneously with a reciprocal feedback loop. Other problems such as endogeneity and heterogeneity due to cross country variation effects of trade and OFDI may yield inconsistent and biased estimates These problems may be addressed using econometric models that accounts for these issues. To this end, this study employs the two-step SYS-GMM and DFF-GMM techniques to estimate the relationship between international trade and OFDI in 161 countries based on world bank income classification such as LIC, LMIC, UMIC, and HIC for the period 1998-2019 to determine whether the macroeconomic factors exhibit complementarity or substitution effects. In addition, this study examines the effects of the 2007–2008 global financial crisis on OFDI and trade in different income groups.

3. Methodology and Data

3.1. Data description

This study uses the yearly panel dataset of 161 countries grouped according to the world bank country income classification which includes, the LIC (22 countries), LMIC (41 countries), UMIC (47 countries), and HIC (51 countries), over the period of 1998–2019. The study variables and data sources are presented in Table 1. Whilst the choice of country selection was based on the availability of dataset, variable selection was informed by the theory and analysis of previous studies (Ito et al., 2020; Kamal et al., 2019). The variables of interest are the aggregated international trade (total trade) and OFDI flows which alternate as dependent and independent variables in the model so as to capture the bidirectional causal effects in country's income clusters. However, the study controlled for certain factors that may affects the relationship between OFDI and international trade, as failure to do so, might compromise the internal validity of results, thus numerous economic factors such as GDP, INFR, and INST, were controlled for in the experimenting investment and trade models.

Figure 2 shows the cross-country correlation of different income groups on the relationship between OFDI and international trade for the period 1998–2019. OFDI and trade for LMIC, UMIC and HIC is set in-between two boundaries for vast majority of countries within the range of a minimum close to zero and a maximum close to 4 and suggests a positive contemporaneous link between OFDI and international trade. Neverthe-

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less, OFDI and trade partly lies between positive and negative axis in LIC group, and the correlation trend suggests negative relationship between OFDI and international trade. This observation gives initial possible evidence of a contemporaneous relationship that does not account for observable explanatory variables including controls for time and country dimensions. In addition, it does not adjust for endogeneity and heterogeneity concerns, however these issues are tackled in our empirical analysis.

3.2. Econometric technique & model specifications

Based on theoretical background, and the empirical literatures in the relationship between OFDI and international trade as discussed in section 2, this study examines the interactions between OFDI and trade using the SYS-GMM and DFF-GMM techniques. The use of the first-difference transformation (one-step GMM) may cause internal transformation problem leading to loss of many observations (Roodman, 2009; Arella-

Table 1

Definitions of variables and data sources

Variable	Definition	Unit	Sign	Source
OFDI	The natural logarithm of foreign direct investment net outflows as a % of GDP	Constant 2010 US$	+/–	UNCTAD (2020)
TRD	Total trade measured in natural logarithm	Constant 2010 US$	+/–	World Bank (2020)
GDP	The real Gross Domestic product per capital (market size) in logarithm	Constant 2010 US$	+/–	World Bank (2020)
INST	Institution composite index	Composite index	+	WGI (2020)
INFR	Overall Quality of infrastructure	Composite index	+	WEF (2019)
POP	Size of home country (total population) measured in natural logarithm	Annual	+	World Bank (2020)
GFC	Dummy 1 for year of crisis, 0 otherwise	Scale	–	Author's construction

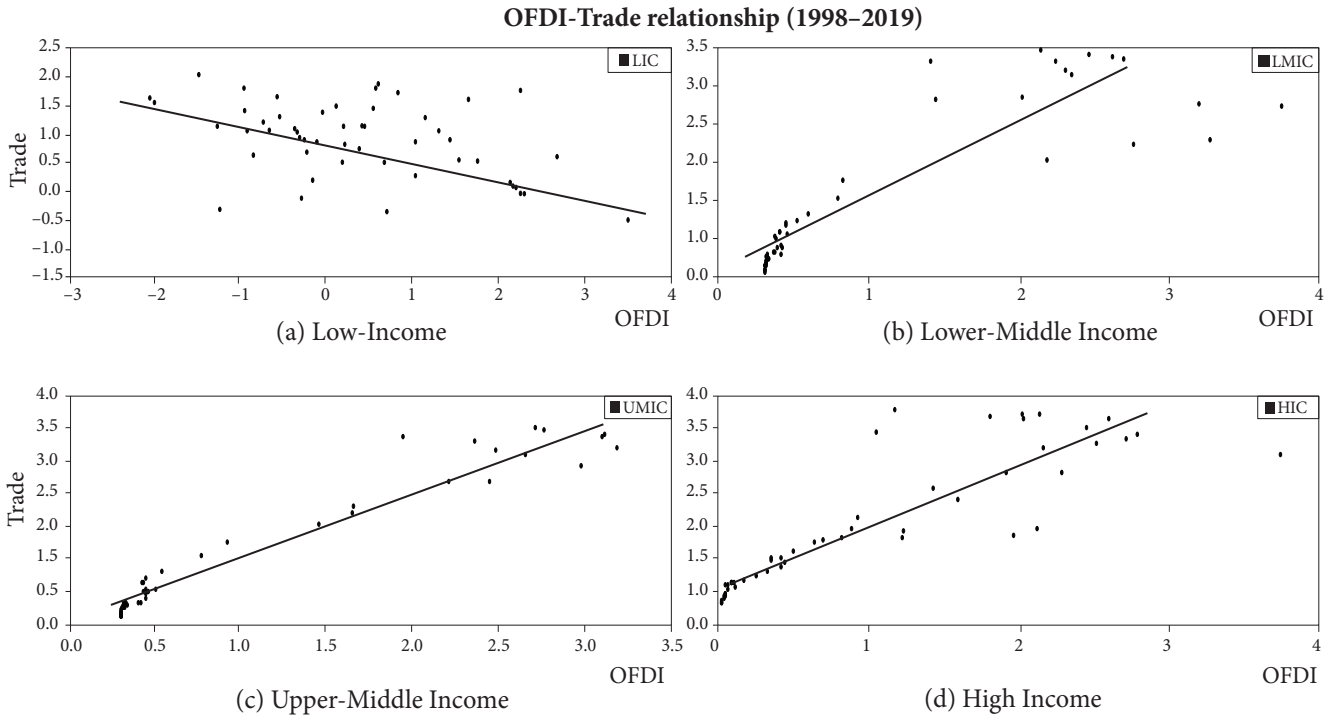

Figure 2. *Shows a positive relationship between FDI outflows and total trade based on country economic income. The Horizontal line indicates natural log of FDI outflows, and the vertical line represents the natural log of Total trade*

Source: Authors' calculations using data from https://data.worldbank.org/

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no & Bover, 1995). However, this can be avoided using the second order transformation (two-step GMM), and on this account, this study employs the two-step GMM estimators to investigate the OFDI-trade relationship. We estimate the trade and investments models in logarithmic forms, except the crisis dummy (GFC) variables. Equation (1) and (2) shows the trade and investment models respectively.

Model I

$$TRD_{i,t} = \gamma TRD_{i,t-1} + \delta OFDI_{i,t} + \beta_1 GDP_{i,t} + \\ + \beta_2 INST_{i,t} + \beta_3 INFR_{i,t} + \\ + POP_{i,t} + GFC_{2007} + GFC_{2008} + \varepsilon_{i,t} \quad (1)$$

$$\varepsilon_{i,t} = \eta_i + u_i.$$

Model II

$$OFDI_{i,t} = \gamma OFDI_{i,t-1} + \delta TRD_{i,t} + \beta_1 GDP_{i,t} + \\ + \beta_2 INST_{i,t} + \beta_3 INFR_{i,t} + + POP_{i,t} + \\ + GFC_{2007} + GFC_{2008} + \varepsilon_{i,t} \quad (2)$$

$$\varepsilon_{i,t} = \eta_i + u_i,$$

where $i = 1, \ldots, N$ and $t = 1, \ldots, T$, γ, δ, and β are parameters to be estimated. The subscript i and t denotes country and year respectively. $TRD_{i,\,t-1}$ and $OFDI_{i,\,t-1}$ is the one-period lagged country's trade and investment respectively. Model I is the Trade model applied to home country the aggregated trade for the period 1998–2019. Model II is the investment model applied to home country direct investment abroad. The term ε_{it}, u_i and η_i are the disturbance, the unobserved country-specific effects and unobserved time specific effects respectively.

4. Results & discussion

4.1. Description statistic

Table 2 summarizes the variables statistics applied in the study. Its shows the main variables – OFDI and TRD and other set of controlled microeconomic factors that can affect OFDI and trade relationship of home country for different income economies groups. This includes GDP, INST, INFR and POP institution and economic growth relationship. The average flow of OFDI reduces moving from HIC (1.917) to LIC (1.007), this indicates that there is higher investment outflow from high wage countries compared to poor income countries. However, standard deviation appears to be higher in LIC (0.989) compared to the other income growth. This show that volatilities is much higher in LIC than the other group of income economies. International trade volume seems to be higher in UMIC (0.737), followed by trade activities in HI (0.613), while combine volume of export and import is smallest in LIC (0.318). Expected the mean GDP is large and less volatile in HIC and least in LIC with higher volatility for the period 1998–2019. However, the mean values of the descriptive statistics for INST and INFR shows to reduce moving from HIC to LIC.

4.2. Impact of OFDI on trade across income groups

Table 3 presents the empirical results of the trade model shown in equation (1), impact of OFDI on trade across income groups such as LIC, LMIC, UMIC and HIC using the two-step SYS-GMM. The lagged trade term for all specification for income groups are positive and statistically significant, but their values are less than one. This

Table 2

Summary statistics for world bank income economies cluster 1998–2019

	High-Income				Upper-M. Income				Lower-M. Income				Low-Income		
	Obs.	Mean	St. d.		Obs.	Mean	St. d.		Obs	Mean	St. d.		Obs	Mean	St. d.
TRD	1122	0.613	0.372		1034	0.737	0.235		902	0.411	0.334		484	0.318	0.333
OFDI	1122	1.917	0.827		1034	1.796	0.774		902	1.499	0.892		484	1.007	0.986
GDP	1122	1.119	0.121		1034	1.176	0.521		902	0.301	0.863		484	0.297	0.767
INST	1122	0.672	0.109		1034	0.538	0.112		902	0.331	0.102		484	0.160	0.084
INFR	1122	8.911	3.400		1034	6.042	8.590		902	3.091	7.814		484	0.253	10.09
POP	1122	1.532	3.706		1034	2.314	8.573		902	3.794	11.04		484	5.334	13.66

Note:
1. Sources: Data sources is from https://data.worldbank.org/
2. Author's calculations

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indicates that changes in the explanatory variables at a specific point in time influence the current period. According to Table 3, it can be noted that except for LIC, there is a significant positive relationship between OFDI and Trade in LMIC, UMIC and HIC. This implies that a 1% expansion of overseas production (OFDI) may increase trade by 0.093%, 0.197%, 0.200% for LMIC, UMIC and HIC respectively and indicate a complementary relationship. However, negative relationship of OFDI-trade in LIC suggests a substitutional relationship. This suggests "OFDI-supporting trade" that cause import for home country via backward vertical integration or spillover effects and stimulates export due to enhanced competitiveness with the local firms. OFDI spillover may encourage monetary development of economies through repatriation of investment returns and facilitates technical know-how and skills to home country which improve the economy.

However, in LIC (see Table 3), the "OFDI-supporting trade" concept do not hold implying that home trade does benefit from OFDI – do not cause imports and stimulates export. In addition, the 2007 GFC is insignificant in LIC and LMIC and negatively significant in UMIC and HIC, but in 2008, results indicates that GFC affected all income groups in world economy. Model diagnostic checks of override identification (Hansen test specification) and autocorrelation tests for AR (2) do not rejects the null hypotheses and indicates that the overall performance of the trade model is satisfactory. Thus, the results in Table 3 correctly describe the relationship between OFDI-trade.

Table 3

SYS-GMM estimates of the effects of OFDI on home country's trade

Dependent Variable: TRD	World Bank Country Income Classifications				
	Low-Income	Low-Middle	Upper-Middle	High-Income	All sample
	(1)	(2)	(3)	(4)	(5)
Lagged TRD	0.361*** (7.340)	0.286*** (11.803)	0.405*** (9.643)	0.397*** (10.747)	0.210*** (6.730)
OFDI	–0.046* (–1.670)	0.093* (1.910)	0.197** (2.396)	0.200** (1.994)	0.211*** (2.731)
GDP	0.006*** (2.830)	0.178 (1.490)	0.220* (1.680)	0.397** (2.371)	0.579*** (2.750)
INST	0.018* (2.406)	0.127*** (5.390)	0.279** (2.090)	0.313* (1.694)	0.401 (1.350)
INFR	0.009 (1.410)	0.174*** (2.584)	0.243*** (4.845.)	0.502*** (7.215)	0.585* (1.872)
POP	0.123* (1.660)	0.351** (2.130)	0.132* (1.819)	0.332 (1.450)	0.607** (2.260)
2007 (Global Fin. Crisis)	0.014 (1.000)	0.019 (1.641)	–0.093*** (–2.610)	–0.061*** (–11.080)	–0.174*** (–2.890)
2008 (Global Fin. Crisis)	–0.007* (–1.700)	–0.002** (2.065)	–0.138*** (–4.864)	–0.111*** (–9.002)	–0.103*** (–8.543)
Constant	2.005* (1.676)	1.856*** (4.563)	–2.343*** (–6.238)	–1.116*** (–3.223)	0.793* (1.948)
Year effect	Yes	Yes	Yes	Yes	Yes
Home country effect	Yes	Yes	Yes	Yes	Yes
Regional effect	Not included	Not included	Not included	Not included	Not included
Total Observation	484	902	1034	1122	3542
Instruments/Groups	21/22	27/41	26/47	33/51	67/161
Instrument ratios	1.047	1.518	1.807	1.545	2.402
Arellano-Bond (1) *p*-value	0.001	0.003	0.000	0.002	0.000
Arellano-Bond (2) *p*-value	0.183	0.347	0.298	0.643	0.353
Hansen test p-value	0.201	0.836	0.233	0.427	0.197

Note:
1. TRD is lagged one year, t-statistics are in parentheses.
2. Significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
3. Author's calculation: Sources: Data sources is from https://data.worldbank.org/ Access date (13.09.2021)

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To further examine the consistency of the estimated results shown in Table 3, this study re-estimates the trade regressions model using DFF-GMM technique. The estimated coefficients are informative given that DFF-GMM estimates of lagged dependent variable is downward biased to the SYS-GMM and the technique magnifies gaps in unbalanced panels, hence it may not be consistent. Table 4 presents the estimated results of the impact OFDI on trade using the DFF-GMM estimator. The lagged trade variable is positive and statistically significant across the different income group and implies that the trade model is dynamical stable. The results suggests that OFDI provides a substitutive effect to trade in countries with low wages, but complement trade in LMIC, UMIC and HIC. This finding is consistent with the estimated results using the two-steps SYS-GMM.

The per capital GDP level across income, home country institutional framework, infrastructure development as well as population of home country shows to provide positive effects to trade across income groups which help to improve domestic economy. However, the impact of GFC dummy only shows to affect UMIC and HIC during the year 2007, but in 2008, all income groups were affected. These findings also corroborate the results of SYS-GMM estimates. Table 4 also report the diagnostic test statistics which shows that the Hansen test statistics do not reject the null hypothesis of valid over-identifying restrictions and the p-value of AR(2) test suggests that the trade regression model do not exhibit second-order serial correlation. This implies that trade model as well as the estimated results are robust and correctly describe the impact of OFDI on trade across income group.

Table 4

DFF-GMM estimates of the effects of OFDI on home country's trade

Dependent Variable: TRD	World Bank Country Income Classifications				
	Low-Income	Low-Middle	Upper-Middle	High-Income	All sample
	(1)	(2)	(3)	(4)	(5)
Lagged TRD	0.278*** (4.534)	0.213*** (5.827)	0.368*** (7.532)	0.304*** (9.561)	0.167*** (5.267)
OFDI	−0.036*** (−2.870)	0.97*** (1.731)	0.199** (2.030)	0.198*** (2.187)	0.233** (1.865)
GDP	0.015 (1.360)	0.198*** (4.050)	0.249* (1.720)	0.403 (1.237)	0.593 (0.131)
INST	0.026** (2.370)	0.138** (1.760)	0.288*** (3.531)	0.347*** (2.930)	0.418* (1.671)
INFR	0.028* (1.673)	0.187 (1.540)	0.265* (1.831)	0.519** (2.633)	0.597** (2.131)
POP	0.137 (1.334)	0.370* (1.840)	0.146** (2.330)	0.348* (1.917)	0.625* (2.190)
2007 (Global Fin. Crisis)	0.069* (2.170)	0.012 (0.860)	−0.067* (−1.880)	−0.146* (−1.870)	−0.258* (−1.930)
2008 (Global Fin. Crisis)	−0.002** (3.873)	−0.004** (−5.039)	−0.151* (−1.962)	−0.193*** (−7.116)	−0.111* (−1.873)
Constant	2.232 (1.550)	1.867*** (4.190)	−2.271* (−1.832)	1.018*** (2.920)	0.841** (2.073)
Year effect	Yes	Yes	Yes	Yes	Yes
Home country effect	Yes	Yes	Yes	Yes	Yes
Regional effect	Not included	Not included	Not included	Not included	Not included
Total Observation/Grand	484	902	1034	1122	3542
Instruments/Groups	18/22	23/41	20/47	29/51	62/161
Instrument ratios	1.222	1.782	2.350	1.758	2.596
Arellano-Bond (1) *p*-value	0.003	0.000	0.000	0.001	0.002
Arellano-Bond (2) *p*-value	0.169	0.204	0.236	0.441	0.192
Hansen test overid *p*-value	0.342	0.571	0.186	0.202	0.564

Note:
1. TRD is lagged one year, t-statistics are in parentheses.
2. Significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
3. Author's calculation: Sources: Data sources is from https://data.worldbank.org/ Access date (13.09.2021)

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4.3. The impact of trade on outward FDI across in income groups

Table 5 shows the results from the estimation of the investment model which examines the impact of trade on OFDI across income economic using the two-steps SYS-GMM. The impact of trade on OFDI in LIC is negative and insignificant, implying that a 1% increase in international trade will decrease OFDI flow to foreign countries by 0.103% but the effect is insignificant. Regarding other income groups such as LIMC, UMIC and HIC, findings shows that the coefficient of the relationship is positive which suggests the existence of "trade supporting OFDI" effects which stimulates domestic investment to increase scale of production and upgrade technologies for home countries. The evidence shows that a 1% increase in home trade leads to overseas production expansion (OFDI) by 0.162%, 0.340%, and 0.544% respectively for LIMC, UMIC and HIC. Trade facilitate OFDI to exploit relative factor costs difference in abroad to improve produce and raise capital back home and improve the economy. Finding shows that trade complements OFDI more in the countries with high income compared to other income group, and closely followed by UMIC.

Other remaining variables in the investment model are quite satisfactory. For instance, the GDP, institutions, infrastructure development and population are positive and significant in all income economic groups. This implies that these variables provide supports for domestic trade impact on OFDI. In addition, the statistically significant coefficients of GFC dummy, shows that the

Table 5

SYS-GMM estimates of the effects of home country trade on OFDI

Dependent Variable: OFDI	World Bank Country Income Classifications				
	Low-Income	Low-Middle	Upper-Middle	High-Income	All sample
	(1)	(2)	(3)	(4)	(5)
Lagged OFDI	0.164** (2.130)	0.183*** (2.642)	0.201*** (7.921)	0.147* (1.694)	0.105*** (6.610)
TRD	–0.103 (–1.660)	0.162*** (3.512)	0.340*** (11.453)	0.544*** (2.410)	0.493*** (8.947)
GDP	0.026* (1.790)	0.181** (2.503)	0.320* (1.860)	0.413* (1.670)	0.602** (2.207)
INST	0.008 (1.497)	0.274* (1.657)	0.316* (1.940)	0.507*** (3.335)	0.516 (1.430)
INFR	0.113** (2.010)	0.240* (1.900)	0.456*** (2.550)	0.553 (1.380)	0.376* (1.704)
POP	0.143** (2.370)	0.270* (1.782)	0.335 (1.340)	0.281* (1.687)	0.432 (0.430)
2007 (Global Fin. Crisis)	–0.058* (1.850)	–0.021 (–1.062)	–0.097* (–1.750)	–0.088** (–2.141)	–0.125* (–1.801)
2008 (Global Fin. Crisis)	–0.078 (–0.200)	–0.188*** (–2.590)	–0.115 (–0.120)	–0.156* (–1.740)	–0.107** (–2.400)
Constant	–3.200*** (–4.271)	–3.174 (–1.160)	–1.638* (1.670)	2.301*** (3.744)	2.743* (1.889)
Year effect	Yes	Yes	Yes	Yes	Yes
Home country effect	Yes	Yes	Yes	Yes	Yes
Regional effect	Not included	Not included	Not included	Not included	Not included
Total Observation/Grand	484	902	1034	1122	3542
Instruments/Groups	20/22	29/41	24/47	30/51	53/161
Instrument ratios	1.000	1.413	1.958	1.700	3.037
Arellano-Bond (1) *p*-value	0.000	0.000	0.000	0.001	0.000
Arellano-Bond (2) *p*-value	0.372	0.288	0.197	0.402	0.253
Hansen test overid *p*-value	0.444	0.176	0.252	0.387	0.504

Note:
1. TRD is lagged one year, t-statistics are in parentheses.
2. Significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
3. Author's calculation: Sources: Data sources is from https://data.worldbank.org/ Access date (13.09.2021)

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2007 and 2008 global financial crisis affects OFDI internationalization activities in all economic group, but the crisis appears to deteriorate in 2008 compared to the year 2007. The p values of Hansen tests of over identification and AR (2) autocorrelation tests showed insignificant and do not reject the null hypothesis (see Table 5).

Table 6 shows the results from the investment model using the DFF-GMM estimator. Trade shows to substitutes investment in LIC and LMIC but complements UMIC and HIC groups. Substitutive effects of trade could be due to large national disadvantage which may temporary affect MNCs investments. Thus, domestic firm may export goods and services along investment to foreign country. This can also occur when MNCs relocates abroad due to numerous reasons such as political instability, etc. Except population in LIC which is negative, the results of the other controlled variables are positive and significant which help in stimulating home country trade and OFDI activities. The coefficients of GFC dummy indicates that the financial crisis affected OFDI internationalization activities at different level of income economies in the 2007 and 2008. This results also validate the SYS-GMM estimation on the effect of GFC on OFDI shown in Table 5. However, the overall performance of the investment model based on the diagnostic test statistics (Hansen and AR (1) and (2) tests) is satisfactory which indicates robustness of the estimated coefficients.

Table 6

DFF-GMM estimates of the effects of home country trade on OFDI

Dependent Variable: OFDI	World Bank Country Income Classifications				
	Low-Income	Low-Middle	Upper-Middle	High-Income	All sample
	(1)	(2)	(3)	(4)	(5)
Lagged OFDI	0.105* (1.670)	0.168*** (7.390)	0.188** (2.430)	0.129*** (3.203)	0.101** (2.250)
TRD	–0.100** (–2.230)	–0.171*** (–2.790)	0.387*** (5.000)	0.567*** (4.980)	0.465*** (6.610)
GDP	0.058** (2.770)	0.194* (1.680)	0.333*** (4.360)	0.441* (1.673)	0.621 (0.870)
INST	0.011* (1.652)	0.283 (1.510)	0.323** (2.460)	0.513 (0.410)	0.527** (2.170)
INFR	0.121** (2.690)	0.252*** (2.810)	0.418 (0.870)	0.556*** (3.050)	0.395* (1.910)
POP	–0.145 (–0.110)	0.273 (0.680)	0.347* (1.658)	0.293** (2.570)	0.439*** (2.960)
2007 (Global Fin. Crisis)	–0.036* (1.790)	–0.019*** (4.010)	–0.103** (2.160)	–0.074*** (4.510)	–0.108** (2.105)
2008 (Global Fin. Crisis)	–0.081** (1.982)	–0.169* (–1.890)	–0.122* (–1.970)	–0.147** (2.130)	–0.090* (–1.920)
Constant	1.375 (1.130)	4.128* (1.930)	3.235* (1.690)	–1.621** (–2.061)	2.550* (1.760)
Year effects	Yes	Yes	Yes	Yes	Yes
Home country effects	Yes	Yes	Yes	Yes	Yes
Regional effects	Not included	Not included	Not included	Not included	Not included
Total Observation/Grand	484	902	1034	1122	3542
Instruments/Groups	20/22	28/41	22/47	26/51	49/161
Instrument ratios	1.100	1.464	2.136	1.961	3.285
Arellano-Bond (1) p-value	0.001	0.000	0.000	0.000	0.002
Arellano-Bond (2) p-value	0.189	0.373	0.329	0.504	0.293
Hansen test overid p-value	0.211	0.521	0.173	0.284	0.447

Note:
1. TRD is lagged one year, t-statistics are in parentheses.
2. Significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
3. Author's calculation: Sources: Data sources is from https://data.worldbank.org/ Access date (13.09.2021)

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5. Conclusions

This study examined the linkages between direct investments abroad and home country's trade based on the world bank income clusters (the low-income, lower-middle income, upper-middle income, and high-income) over the period 1998–2019. To account for numerous econometric issues, the SYS-GMM and DFF-GMM techniques are utilized. Empirical results provide new insight which are highly significant but sensitive to different economic income category.

Finding reveals that the impact of OFDI from countries with low wage is negative and significant to the home country's trade, but the reverse effect is insignificant. This indicates that OFDI from these countries substitute domestic trade, and this can be due to many reasons, for instance: Local firms may lack the necessary financial strength for business competitiveness, hence MNCs internationalization activities (OFDI) may substitute trade. MNCs diversify investment in low-income countries due to poor business performance as low-income economies are associated with poor economic indicators. However, in other income groups such as low-middle, upper-middle and high-income countries, OFDI and international trade are mutually complementary which improve home country economy. This suggests that MNCs could be resources-seeking vertical FDI, driven with the desire to exploit factor price differences or market-seeking FDI which tend to repatriate investment returns to improve domestic production. Regarding the impact of 2007–2008 global financial crisis on trade and OFDI across different income groups, findings show that contrary to other income group with negative impact, international trade in low-income and low-middle income countries were not affected by GFC in 2007. Nevertheless, trade and investments in all income categories were affected negatively in 2008.

The study provides several policy implications. In low-income countries where OFDI substitute trade, policymakers should synergize with the relevant government agencies to enact appropriate trade-investment policies as well as provide incentives to support and encourage domestic firm to adequately compete with foreign companies. More funds should be injected into the domestic economy to revamp infrastructure development, institutions, technological upgrading, etc. to facilitate OFDI and trade. In addition, relevant government agencies should monitor firm's internationalization activities to comply with the trade-investment policies of home countries, to ensure that "going abroad" do hollow-out the economy, as this will strengthen and protect the local industries. However, in other income groups, government must sustain policies that provides mutually complementary relationship that stimulates the domestic economy.

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Ranking of transport network development projects in the Sverdlovsk railroad area based on fuzzy logic

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ABSTRACT

Relevance. Due to the turbulence of economic processes in the period of sanctions pressure on the economy, decisions should be made, effective, first of all, from a national position. For this purpose, it is necessary to justify them using multi-criteria and all available information, which at the initial stages is fundamentally incomplete, insufficiently reliable and sometimes weakly formalized. In such cases, it is advisable to use special methods to assess the decisions made in conditions of uncertainty, in particular methods of fuzzy logic and mathematics.

Purpose of the study. The study is aimed at assessing the order of priority of transport rail support on the investigated most important in the federal and regional scale main lines by including the most significant technological and economic criteria, reflecting the nationwide priority.

Data and Methods. To compare different methods of priority construction of the main lines of railway lines, we used the procedure of fuzzy multi-criteria analysis of the projects. The assumed priorities of transport rail support are based on four trunk line projects: the Middle Urals Latitudinal Railway on the N-Tagil – Perm section; the Troitsko-Pechorsk – Ivdel section; the Perm – Chernushka section; the Ust – Aha – Uray – Khanty-Mansiysk – Salym section.

Results. The paper proves the possibility of applying the approach based on fuzzy logic to the analysis of economic processes in the period of shocks to the economy, caused, in particular, by the introduction of sanctions from unfriendly countries. The estimated priority of transport rail support on the four projects of the most important trunk lines is assessed.

Conclusions. With the help of fuzzy logic methods, it is possible to find compromise options that satisfy the various interests of those affecting the decisions, regardless of the structural organization of the backbone industries, one of which is undoubtedly the transport industry.

KEYWORDS

infrastructure projects, transport railway network, freight flows, sanctions pressure, multicriteria, fuzzy sets, expert estimates

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Ранжирование проектов развития транспортной сети в зоне свердловской железной дороги на основе нечеткой логики

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АННОТАЦИЯ

Актуальность. В связи с турбулентностью экономических процессов в период санкционного давления на экономику должны приниматься решения, эффективные, в первую очередь, с общегосударственных позиций. Для этого необходимо их обоснование с учетом многокритериальности и всей доступной информации, которая на первоначальных стадиях обладает принципиальной неполнотой, недостаточной достоверностью и подчас слабой степенью ее формализации. В таких случаях целесообразно применение специальных методов, позволяющих оценивать принимаемые решения в условиях неопределенности, в частности методов нечеткой логики и математики.

Цель исследования заключается в оценке очередности транспортного железнодорожного обеспечения на исследуемых наиболее важных в федеральном и региональном масштабе магистральных направлениях за счет

КЛЮЧЕВЫЕ СЛОВА

инфраструктурные проекты, транспортная железнодорожная сеть, грузопотоки, санкционное давление, многокритериальность, нечеткие множества, экспертные оценки

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включения наиболее значимых технологических и экономических критериев, отражающих общегосударственный приоритет.
Данные и методы. Для сравнения различных способов очередности сооружений магистральных направлений железнодорожных линий использовалась процедура нечеткого многокритериального анализа проектов. Предполагаемые очередности транспортного железнодорожного обеспечения основаны на четырех проектах магистральных направлений: среднеуральский широтный ход (СУШХ) на участке Н-Тагил – Пермь; участок Троицко-Печорск – Ивдель; участок Пермь – Чернушка; участок Усть – Аха – Урай – Ханты- Мансийск – Салым.
Результаты исследования. Доказана возможность применения подхода на основе нечеткой логики к анализу экономических процессов в период шоковых воздействий на экономику, обусловленных, в частности, введением санкций со стороны недружественных стран. Оценена предполагаемая очередность транспортного железнодорожного обеспечения на четырех проектах наиболее важных магистральных направлений.
Выводы. С помощью методов нечеткой логики возможно нахождение компромиссных вариантов, удовлетворяющих различным интересам лиц, влияющих на принимаемые решения независимо от структурной организации системообразующих отраслей, одной из которых несомненно является транспортная отрасль.

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ДЛЯ ЦИТИРОВАНИЯ
Petrov, M.B., Serkov, L.A., & Zavyalova, K.A. (2022). Ranking of transport network development projects in the Sverdlovsk railroad area based on fuzzy logic. *R-economy*, *8*(4), 356–368. doi: 10.15826/recon.2022.8.4.027

模糊逻辑下斯维尔德洛夫斯克地区铁路交通网络的发展项目优先级

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摘要
现实性：由于制裁压力经济进程面临动荡，必须首先从国家层面做出有效决策。这就要求在考虑到多标准和所有可用信息的情况下对其进行论证。而这些信息在初始阶段基本上是不完整、不够可靠、有时还很不正式的。
研究目标：文章通过纳入反映国家优先事项的最重要技术和经济标准，来评估联邦和区域干线上运输铁路供应的优先权。
数据与方法：为了比较确定铁路干线建设优先次序的不同方式，本文采用了模糊多准则决策法。拟议的铁路运输优先项目基于四条干线：中乌拉尔-塔吉尔-彼尔姆段；特罗伊茨克-佩乔尔斯克-伊夫德尔段；彼尔姆-切尔努什卡段；乌斯-阿赫-乌拉伊-汉特-曼西斯克-萨雷姆段。
研究结果：在经济受到冲击期间，特别是不友好国家实行制裁所造成的冲击期内，应用模糊逻辑分析经济进程的可能性已经得到证明。本文对最重要干线四个项目的铁路运输优先级进行了评估。
结论：使用模糊逻辑法，有可能找到满足决策者各种利益的折衷方案。无论骨干产业的结构组织如何，运输部门都是影响决策的最重要部门之一。

关键词
基础设施项目、运输铁路网、货运流量、制裁压力、多标准、模糊理论、专家评估

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Introduction

The sanctions war declared by Russia in response to its decisive actions to protect Donbass has significantly changed the structure of transport flows throughout the EAEU. The dominance of east-west cargo flows has been replaced by an increasing transport load on the network in the direction of China and the Asia-Pacific region. The largest cargo flows are formed by natural gas exports from Russia via pipelines and coal exports via the eastern railroads. The most important new direction of foreign economic flows in the medium term will be the southern one, where Russia's largest partner will be India, as well as transit states of Central Asia and the Middle East.

Infrastructure projects in the coming period, on the one hand, are an opportunity to ensure economic ties both within the country and inter-

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nationally. And on the other hand, intensifying the construction of new infrastructures is a way to maintain domestic demand for investment products and, thus, a way to ensure the sustainability of the Russian economy, income, which is also very important in a special period.

The development of Russia's rail network is outlined until 2035 in the Transport Strategy of the Russian Federation[1] and the Strategy for the Development of Rail Transport in Russia[2]. The dominant feature of the first of these documents is a set of strategic initiatives for the long-term planning of modes of transport and the main-line transport infrastructure as a whole. The second one specifies strategic provisions for railway transport, highlighting the strategic vision of all elements of the railway transport system of its network, rolling stock, management system. Simultaneously with its development of railway lines in the territories not yet covered by the network of railway transport, and the second – the concentration of investment resources, especially its own, on income-generating directions and elimination of "bottlenecks" that limit the passage of existing flows. At the same time in recent years there has been a very slow increase in the operational length of Russian railroads. But the additional financial and production resources released due to the sanction's regime allow us to bring closer the start of the construction of new additional rail lines. They will improve transport accessibility and the conditions for locating new production facilities.

Over the past 20-30 years, there are numerous project initiatives to develop the network in the Greater Urals area. These initiatives are associated with the need to prepare new resource bases, diversify the production profile of many territories, with a sharp increase in the volume of transit traffic, the development of the Russian Arctic, the global reorientation of major international economic flows and other key factors of economic development. Meanwhile, in view of the fundamental limitations of development resources, it is necessary to select priorities and appropriate ranking of investment projects for the development of the transport network with cyclic monitoring and updating.

Work on the development of strategic plans, programs and projects has intensified since 2014, when the Law "On Strategic Planning in the Russian Federation"[3] replaced the Law on State Forecasting and Programs of Socio-Economic Development of the Country.

After that, most of the current policies and programs adopted. In connection with them, the list of project initiatives began to expand rapidly. Not all of them quickly pass into the category of ongoing projects. For example, one of the largest projects started in 2009, the Industrial Urals – Polar Urals project to build a new 814-kilometer-long railroad from Polunochnoye station to Obskaya station along the eastern slope of the Ural Mountains, was subsequently frozen for an indefinite period of time. Other major railroad construction projects around the Urals North have gained real priority: the Northern Latitudinal Railway, as well as projects for a large railroad diagonal in the direction of new ports on the Arctic coast of European Russia, which are currently under study. The list of prospective transport network projects in the JSC "Russian Railways" portfolio is now extensive. Unfortunately, there are no project initiatives for the Urals, including the Sredneuralsky Latitudinal Railway, on the head section of which (the section from Bolsheselsky near Tobolsk to Tavda) design work has been completed. This section plays an important transport-economic and geopolitical significance, as it would become the second railroad crossing between the Urals and Siberia after the Trans-Siberia Railway, running exclusively through Russian territory.

Until the issue of the unity of state planning in the development of the railroad network is resolved, local conflicts on the actualization of project portfolios will be entrenched, which means that project initiatives of uncertain status will coexist for a long time. Some initiatives, not yet supported by the industry, may be very valuable for the regions.

There are project proposals for the construction of local sites that cannot be implemented at the same time, but also cannot be considered as alternatives. These are not variants of a major project, but rather different independent projects, so it is not valid to compare them directly. But all the same, the urgency and priority of such projects must be assessed, including for the pos-

[1] Transport strategy of the Russian Federation until 2030 with the forecast for the period until 2035. Approved November 27, 2021, No. 3363-r.

[2] Strategy of railway transport development in the Russian Federation until 2030. Approved June 17, 2008, No. 877-r.

[3] Federal Law "On Strategic Planning in the Russian Federation" of 28.06.2014 No. 172-FZ (last edition). Consultant.ru. date of reference 19.06.2022.

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sibility of their inclusion in newly developed programs. It is extremely difficult to reliably measure their importance relative to each other, because they are not interchangeable. There is extremely insufficient and poorly reliable information on their evaluation.

This kind of assessment needs a special model-methodological toolkit for the full generalization of not always structured expert knowledge. To solve the problem of its effective application we propose the simulation of aggregate expert assessment with elements of fuzzy logic.

A set of several of these kinds of project initiatives is selected as the object of evaluation. We included four new rail lines that are potentially necessary to strengthen the transport network. Their selection for further analysis by the proposed method is carried out in the logic of a gradual transformation of the network structure from predominantly tree-like on a framework of main lines to a complex closed large transport grid (Petrov, 2019; Petrov, 2021). There are powerful highways of latitudinal orientation, but very weak rail connections even between neighboring regional centers in the meridional direction.

Project P1: continuation of the Middle Ural Latitudinal Railway with passage through the Urals along the route Nizhny Tagil (Smychka station) – Perm. The purpose is to strengthen the connection between the Urals and the European part of Russia and to increase the carrying capacity for unloading the main route Tyumen – Yekaterinburg – Perm.

Project P2: Troitsko-Pechorsk section (now a dead end railroad in the southeast of the Komi Republic) – Ivdel (a dead end station Polunochnoye in the far north of the Sverdlovsk Region) with a crossing over the Urals Ridge. Destination – the Urals element of the future main line port Indiga on the Northern Sea Route – Komi – Urals (BarentsKomUr).

Project P3: Perm – Chernushka section (south of Perm Krai on the main line of the Moscow – Kazan – Yekaterinburg railroad). Purpose: creation of the currently missing railway connection between the city of Perm and the southern part of Perm Krai and organization of a through meridional railway route from the north of the region (Solikamsk) to its south (Chernushka).

Project P4: the Ust'-Akha section (now a dead-end station in the Tyumen Region from the Sverdlovsk Region on the Tavda – Ust'-Akha line) – Uray – Khanty-Mansiysk – Salym (station on the meridional course Tyumen – Surgut). The purpose is to create an element of the large transport grid by connecting the dead-end entrance from the Sverdlovsk region to the Tyumen region with the main railway line of the Tyumen region and to provide the city of Khanty-Mansiysk with railway transport (Fig. 1).

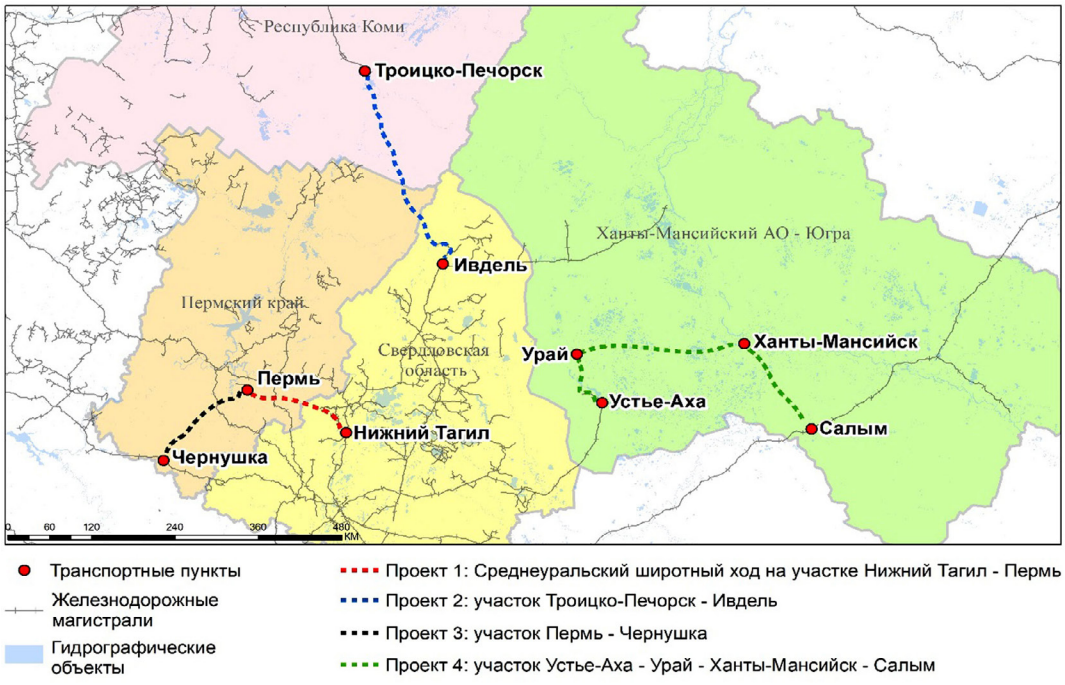

Figure. 1. *Map of compared projects*
Source: the authors' calculations.

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Such a set of possible projects requires ranking them according to their complex significance. But for a number of criteria, it is not possible to give a reliable specification of the target functions of these criteria under turbulent conditions. Nevertheless, the meaning of the most important criteria for evaluating transport projects lies a priori in the selection of projects. Among the most important criteria for evaluating transport network development projects, we include 6 criteria: the promotion of diversification of the territory of the line; the presence of a freight base in this territory; the impact of the line on the expansion of the "bottlenecks" of the network; the contribution of the line to transport accessibility; the total capital investment of the project; the operating costs of the new line.

Thus, the aim of the proposed study is to assess the priority of transport rail provision on the most important federal and regional trunk lines under investigation.

The objectives of this study are a process of pairwise comparison of elements of sets (projects and criteria) based on the most significant technological and economic requirements reflecting the national priority and a formalised procedure of fuzzy multi-criteria analysis in relation to comparison of different methods of priority construction of trunk railway lines.

Based on expert comparisons of projects by criteria and on paired comparisons of the relative importance of the criteria, using the maximum method, the degrees of affiliation of a fuzzy solution are determined, the maximum value of which corresponds to the best trunk line project. The best project out of all those considered, satisfying the criteria considered, is the continuation of the Middle Ural Latitudinal Railway on the N.-Tagil – Perm section.

The logic of the study is based on scientific sources on the methodology of transport network development, transport forecasting, logistics, regional economics and geoeconomics.

Theoretical basis

Articles (Vakulenko, 2021) show that it is necessary to develop railroads, which contributes to the retention of positions in the transportation market and increase the competitiveness of rail transport. It is possible to specialize the existing railways into lines with freight and passenger traffic, but the implementation of such projects in places with low road density leads to overrun trains and an increase in the cost of freight and passenger delivery. The departure of freight trains from these lines leads to the loss of the freight base and increases the losses of Russian Railways. It is proposed that new specialized high-speed lines be built in places with high passenger traffic in order to solve this problem (Kolin, 2015)

Articles (Pyanikh, 2020) state that Russia's inclusion in modern multimodal corridors will reduce economic dependence on other countries and strengthen its position in world markets. Russia's geographical position is a natural transport corridor and its use allows it to increase transit potential, taking into account the development of railroads in the direction of China and other Asian countries along the Trans-Siberian Railway, as noted in the article (Stroganov, 2016). Well-established freight shipping along the Northern Sea Route and the construction of the Transpolar Mainline will strengthen Russia's position in the struggle for the most important transoceanic communications connecting the Atlantic and Pacific Oceans.

The ever-increasing sanctions pressure from the West leads to the need for import substitution in the country. The Russian import substitution policy is designed to reanimate and modernize missing elements of production or create new ones. Having analyzed the level of technology by industry, about two thousand areas of import substitution have been identified (Medovshchikov, 2020). For JSC "Russian Railways" the main issue in import substitution is the transition to domestic software, as for him the priority is to ensure security "to anticipate, if possible, to avoid, if necessary to act". Functional security aims to avoid dangerous situations. Information security to preserve the integrity and confidentiality of information. When there is great uncertainty in incoming information, cybersecurity makes it possible to prevent the loss of train controllability under conditions of artificial distortion of information (Sviridova, 2019).

As noted in the works (Kochneva, 2021) regional container transportation systems operate under conditions of significant incomplete information and lack of integration of economic entities. The companies involved in this system pursue only their own economic interests (Ghadimi, 2019). An approach to the integrated management of this system in the region is proposed, using the mutual exchange of information between railroads (Kayikci, 2018), freight owners, terminals

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and resource owners (Cleophas, 2016), which can be implemented on the basis of a digital logistics platform that will ensure the formation of effective logistics chains, as noted in the work (Reser, 2016), which is important in the period of sanctions pressure.

As shown in (Greenberg, 2021) economic sanctions against Russia were imposed by the West in 2014 and in order to effectively counteract them, it was necessary to determine the conditions under which they have the greatest negative impact on our country. It was found that the costs of sanctions pressure are higher for the target country than for the instigator country and the preferred type of sanctions – targeted sanctions, as it turns out, are less effective than traditional comprehensive sanctions, as shown in the article (Cortright, 2018).

The creation of an interconnected system for determining the prospective demand for freight rail transportation between regions, allowing the development of transport infrastructure and regional connectivity to be determined, is important (Shirov, 2021). The result of this work was the development of tools to justify the strategic development of the railway system, to assess the possible interaction between the economy and the railway transport. The work (Myslyakova, 2021) notes that for the effective operation of an industrial region during significant external shocks, it is important to determine the connectivity of the region as an indicator of the integrity of socio-economic relations, taking into account the peculiarities of infrastructural inter-subject interaction.

According to P.A. Minakir, at the stage of 2015-2017, the reorientation of Russia's exports to the East was justified by the dynamics of opportunities in Eastern markets with their expanding demand for Russian raw materials and energy, and opportunities for Russia to increase export rents (Minakir, 2017; Wirth, 2014). The radical change in world economic relations observed in 2022 essentially makes the reversal of the largest export flows to the East a no-regret option. China, Indonesia, Vietnam, and a number of other Asian countries are, to a large extent, Russia's current and, to an even greater extent, future strategic partners. The countries of the East and, in the future, of the South will form a new geo-economic and geopolitical center of development, with which Russia will have to build relations in foreign trade, capital movement, technology exchange and humanitarian contacts, as shown in the article (Akaha, 2014). Therefore, the processes of increasing economic potential in eastern Russia will also accelerate, which may cause or increase the need for certain transport infrastructure facilities in the Greater Urals area. Thus, of the four projects we selected for fuzzy analysis, projects A, B and D can be classified in this category.

This analysis is based on the apparatus of fuzzy sets (Limbu, 2007) and fuzzy logic (Hu Zhaoguang, 2002; Sasaki, 1999).

Methods and data

One of the promising decision-making tools in the context of sanctions policies by unfriendly countries is the theory of multiple-criteria decision-making, which received further development in accordance with the development of fuzzy sets theory (Bellman, 1976).

As noted in the Introduction, a fuzzy multi-criteria project analysis procedure to compare different ways of prioritizing the construction of trunk rail lines served as an example. This procedure is part of the fuzzy decision-making methodology according to the Bellman-Zadeh scheme (Bellman, 1976).

Fuzzy logic operates with fuzzy sets, which provide a mathematical way of representing uncertainty and fuzziness, particularly in the economic and social sciences. Formally a fuzzy set Θ is defined (Shtovba, 2007) as a set of ordered pairs of the form $< x, \mu_{\Theta}(x) >$, where x is an element of some universal set X, and $\mu_{\Theta}(x)$ – is a degree of membership which puts in correspondence to each element of $x \in X$ some real number from the interval [0, 1]. Thus, a fuzzy set – is a set of elements with different degrees of memberships. In this case, the comparison of each element of its degree of belonging to a fuzzy set is carried out with the help of the membership function (MF).

The proposed article uses the indirect method for determining the values of MF (Leonenkov, 2005), since there are no measurable properties that can be used to construct a fuzzy set of the subject area under consideration. For this purpose, the method of pairwise comparisons, based on intuition or on performing certain logical actions, formalized by constructing a symmetric diagonal matrix with reciprocal elements of the same name, is used. In this case, the problem of constructing the MF is reduced to finding such a vector w, which is a solution of the equation:

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$$A \cdot \mathbf{w} = \lambda_{max} \cdot \mathbf{w}, \ \mathbf{w} = (w_1, w_2, ...w_n), \quad w_1 + w_2 + ...w_n = 1, \tag{1}$$

where λ_{max} is the largest eigenvalue of the matrix of pairwise comparisons A, n – is the number of elements of the fuzzy set.

The process of pairwise comparison of elements is based on intuition or on performing some sequence of logical actions. Note that it is the indirect method of determining the MF used by the authors in the proposed article.

Formalized procedure of fuzzy multi-criteria analysis as applied to the task of comparing different methods of ordering of the construction of the main directions of railway lines consists of the following steps.

1. Setting a set of trunk projects that are subject to multicriteria analysis : $\boldsymbol{P} = \{P1, P2, \ldots, P4\}$.

2. Setting a set of criteria, according to which trunk projects are evaluated $\boldsymbol{G} = \{G1, G2, \ldots, G6\}$.

3. Based on the expert comparisons of projects by criteria, paired comparison matrices are determined on the Saati scale.

4. Finding the coordinates of the eigenvector of the matrix of pairwise comparisons, corresponding to the maximum eigenvalue. Obtaining fuzzy sets for each criterion, each element of which corresponds to a certain project. The number of fuzzy sets is equal to the number of criteria. The sum of degrees of memberships must be equal to one.

5. Based on the pairwise comparisons of the relative importance of the criteria, the matrix of pairwise comparisons of the importance of the criteria is formalized and, in accordance with equation (1), quantitative estimates of the coefficients of relative importance of the criteria are obtained.

6. Raising each element of the set obtained at the fourth stage to the degree corresponding to the coefficient of the relative importance of the criteria, we obtain fuzzy sets of criteria, using their relative importance.

7. The intersection of these fuzzy sets (minimization procedure) allows you to determine the degree of membership of the fuzzy solution, the maximum value of which corresponds to the best trunk project.

8. Based on the degrees of memberships found in the eighth step, an membership function is constructed (indirect method of constructing the MF).

As a result of performing the described procedure, you can not only choose the best option for the criteria of the project, but also to analyze the different options. That is, to find the answer to the question "What should be changed in some alternative to make it the best? To do this, you need to change one of the pairwise comparisons and monitor the resulting solutions.

Results

As noted in the Introduction, the proposed queues of transport rail support are based on four main line projects: $\boldsymbol{P} = \{P1, P2, \ldots, P4\}$, where $P1$ element corresponds to the Middle Urals Latitudinal Railway on the N-Tagil – Perm section, $P2$ – to the Troitsko-Pechorsk – Ivdel section, $P3$ – to the Perm – Chernushka section, and $P4$ – to the Ust – Aha – Uray – Khanty-Mansiisk – Salym section.

Accordingly, the set of criteria, in accordance with which projects are evaluated, includes six elements $\boldsymbol{G} = \{G1, G2, \ldots, G6\}$, where the element $G1$ corresponds to the degree of diversification of industries in the territory of the trains passing, $G2$ – cargo base, $G3$ – expansion of "bottlenecks" (the capacity of the main directions), $G4$ – transport accessibility of points of passing lines, $G5$ – total investments, $G6$ – total operating costs of existing traffic flows.

The expert comparisons of the projects $\boldsymbol{P} = \{P1, P2, \ldots, P4\}$ according to the six $\boldsymbol{G} = \{G1, G2, \ldots, G6\}$ criteria were conducted on the basis of the benefits assessment scale (Saaty scale (Saaty, 1993)) shown in Table 1. Six pairs of projects were compared for each criterion. These expert comparisons are shown in Table 2.

The expert statements shown in Table 2 correspond to the following matrices of pairwise comparisons of 4x4 for each criterion (written in string form).

Table 1

Evaluating the advantage of projects

№	Type of advantage	Evaluation
1	No advantage	1
2	Weak advantage	3
3	Significant advantage	5
4	Absolute advantage	7

Source: the authors' calculations.

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Table 2

Paired comparisons of projects on the Saati scale

№	Projects	Best project	Advantage	Evaluation
		*G*1		
1	1–2	2	Significantly	1/5
2	1–3	3	Weak	1/3
3	1–4	4	Absolutely	1/7
4	2–3	2	Significantly	5
5	2–4	4	Significantly	1/5
6	3–4	4	Significantly	1/5
		*G*2		
1	1–2	2	Significantly	1/5
2	1–3	1	Significantly	5
3	1–4	4	Weak	1/3
4	2–3	2 = 3	No	1
5	2–4	2	Weak	3
6	3–4	3 = 4	No	1
		*G*3		
1	1–2	1	Significantly	5
2	1–3	1	Significantly	5
3	1–4	1	Weak	3
4	2–3	3	Weak	1/3
5	2–4	4	Significantly	1/5
6	3–4	4	Significantly	1/5
		*G*4		
1	1–2	1 = 2	No	1
2	1–3	1	Weak	3
3	1–4	4	Significantly	1/5
4	2–3	2	Significantly	5
5	2–4	4	Weak	1/3
6	3–4	4	Significantly	1/5
		*G*5		
1	1–2	1	Weak	3
2	1–3	3	Significantly	1/5
3	1–4	1	Weak	3
4	2–3	3	Absolutely	1/7
5	2–4	2 = 4	No	1
6	3–4	3	Absolutely	7
		*G*6		
1	1–2	1	Weak	3
2	1–3	3	Weak	1/3
3	1–4	1	Significantly	5
4	2–3	3	Significantly	1/5
5	2–4	2	Significantly	5
6	3–4	3	Significantly	5

Source: the authors' calculations.

Given the limited size of the article, we specify only the matrix of pairwise comparisons, corresponding to the criterion *G*1

$$A(G1) = \begin{bmatrix} 1 & 1/5 & 1/3 & 1/7 \\ 5 & 1 & 5 & 1/5 \\ 3 & 1/5 & 1 & 1/5 \\ 7 & 5 & 5 & 1 \end{bmatrix}.$$

In the given matrices all elements correspond to pairwise comparisons of Table 2 and the conditions of diagonality and inverse symmetry of matrices. Based on equation (1) we obtain fuzzy sets of all criteria, the elements of which are shown in Table 3.

Table 3

Elements of fuzzy sets for each criterion

	***P*1**	***P*2**	***P*3**	***P*4**
*G*1	0.0490	0.2482	0.0944	0.6078
*G*2	0.2116	0.4219	0.1544	0.2122
*G*3	0.5283	0.0610	0.1057	0.3050
*G*4	0.1633	0.2124	0.0655	0,5588
*G*5	0.1911	0.0760	0.6570	0.0760
*G*6	0.2655	0.1427	0.5354	0.0564

Source: the authors' calculations.

These fuzzy sets are given without using the relative importance of the criteria for evaluating energy supply projects. To take into account the relative importance of the criteria, we again use the expert method based on linguistic statements regarding pairwise comparisons of the importance of the criteria. Based on the linguistic statements, all project evaluation criteria are ranked on a six-point scale, shown in Table 4.

Table 4

Ranking the criteria according to their importance

Criterion	Rank
1. Diversification	2
2. Cargo base	1
3. Bottlenecks	5
4. Transport accessibility	3
5. Total capital investment	4
6. Operating costs	6

Source: the authors' calculations.

Comparing the values of the criteria given in Table 4, we can conclude that the criteria related to operating costs and throughput capacity of trunk routes are the most important for making

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decisions on the projects. The criterion assessments given in Table 4 correspond to the following matrix of pairwise comparisons of dimension 6x6 (written in string form).

$$A = \begin{bmatrix} 1 & 2 & 2/5 & 2/3 & 1/2 & 1/3 \\ 1/2 & 1 & 1/5 & 1/3 & 1/4 & 1/6 \\ 5/2 & 5 & 1 & 5/3 & 5/4 & 5/6 \\ 3/2 & 3 & 3/5 & 1 & 3/4 & 1/2 \\ 2 & 4 & 4/5 & 4/3 & 1 & 4/6 \\ 3 & 6 & 6/5 & 2 & 6/4 & 1 \end{bmatrix}.$$

Based on equation (1), the normalized degrees of relative importance of the criteria are determined:

$$a1 = 0.0952;$$
$$a2 = 0.0476;$$
$$a3 = 0.2381;$$
$$a4 = 0.1421;$$
$$a5 = 0.1905;$$
$$a6 = 0.2857,$$

where $a1$, $a2$, ..., $a6$ – the relative importance of the criteria $\boldsymbol{G} = \{G1, G2, \ldots, G6\}$. To find the degrees of membership of fuzzy sets, considering the importance of the criteria, it is necessary, according to (Awasthi, 2018; Khorasani, 2018), each element of these sets to a power with the index equal to the relative importance of the criteria. As a result, we obtain the following final fuzzy sets of criteria, considering their importance. (Table 5).

To select the best transport supply project in terms of the set of criteria, a maximization approach is used (Nazari, 2018), which consists in minimizing the fuzzy sets for each criterion for each project and then maximizing the resulting fuzzy set to select the best project.

Table 5

Elements of fuzzy sets for each criterion given their importance

	P1	*P2*	*P3*	*P4*
G1^a1	0.7396	0.8699	0.7898	0.9514
G2^a2	0.9253	0.9578	0.9108	0.9254
G3^a3	0.8580	0.5111	0.5831	0.7250
G4^a4	0.7759	0.8050	0.6828	0.9218
G5^a5	0.7302	0.6129	0.9233	0.6129
G6^a6	0.6807	0.5686	0.8343	0.4344

Source: the authors' calculations.

The minimization operation of the criteria is to intersect the above final fuzzy sets of criteria for each project. As a result, we get the following fuzzy set:

$$G_{\min} = \{0.68,\ 0.51,\ 0.58,\ 0.43\}$$
$$\text{P1}\quad \text{P2}\quad \text{P3}\quad \text{P4}$$

This fuzzy set indicates a clear advantage of the project A, i.e., the advantage of the project to continue the Middle Urals Latitudinal Railway on the Nizhny Tagil – Perm section. This project satisfies all the criteria considered better than others.

A comparison of the examined projects based on the membership functions is shown in Figure 2. The figure shows that the distance between the projects for the most important criteria *G3, G6* and the other criteria is much more significant compared to the distance between the projects for unimportant project criteria. From the membership functions shown in Figure 1, you can also analyze which projects are more or less preferred by which criteria.

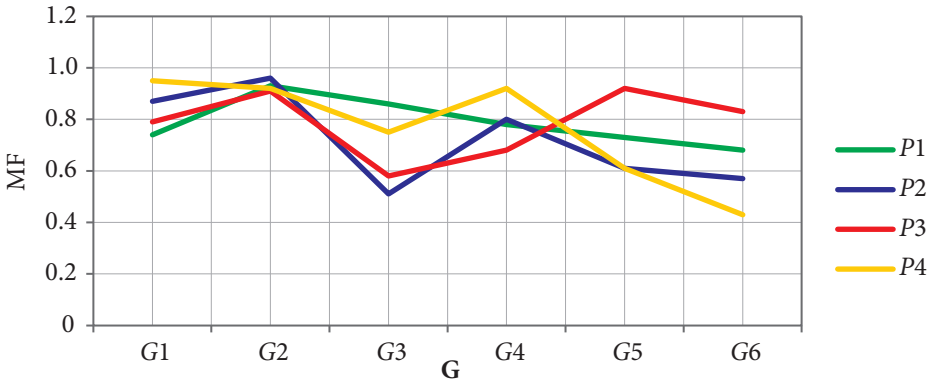

Figure 2. *Membership functions (MF) of P = {P1, P2, ..., P4} projects with regard to the importance of criteria G = {G1, G2, …, G6}*

Source: the authors' calculations.

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Thus, the following hierarchy of projects in order of importance and priority was obtained as a result of the experiment: 1) Sredneuralsky Latitudinal Railway on the N.-Tagil – Perm section (project *P1*); 2) Perm – Chernushka section (project *P3*); 3) Troitsko-Pechorsk – Ivdel section (project *P2*); 4) Ustye – Aha – Uray – Khanty-Mansiisk – Salym section (project *P4*).

The sequence of infrastructure projects selected for analysis at the beginning of the article is based on the intuitive assumption that they are arranged in descending order of importance. All of these projects correspond to the paradigm of the formation of a large transport grid and rely on serious factors of their justification. At the same time, they are very dissimilar network projects. Their direct technical and economic comparison is ambiguous, including because the regions and stakeholders involved in them compete. And the projects themselves, although they do not replace each other in any way, compete for development resources. When moving from the pre-project stage to the preparation of supporting materials for each of these projects, each time it is necessary to carefully adapt the overall methodological scheme of evaluation. Namely, it is always important to choose a system of reference of costs and results and take into account the interests of indirect beneficiaries.

According to the results of the study, we see that on the basis of the applied method it is possible to rank directly non-comparable projects on the basis of the formalization of the expert procedure. And the obtained ranks of significance in this case only partially confirmed our implicit hypothesis about the sequence of projects in terms of their significance.

In this article, we did not set out to perform justifications, but explained the motives for selecting projects for analysis by formalizing fuzzy logic and performed the corresponding calculations to simulate and summarize expert evaluations. The experts involved in different aspects of the development of the railway transport network arranged our intended criteria by importance and gave relative pairwise preferences for the proposed four projects. Thus, a multi-criteria expert evaluation of the projects was made, which shows another undoubted advantage of the applied procedures. The principle of multi-criteria is the most difficult to observe in a specific justification. In this case, according to the applied methodology, the nuances of expert motivation of preferences are not important, but the result of the aggregate expert evaluation is important. For this purpose, we converted linguistic variables into quantitative values and constructed membership functions, which gave the desired result.

Turbulent times can unexpectedly bring some projects, not widely promoted in the previous period, to the top of the priority list. Our initial assumption is that the Perm – Chernushka line is not a priority, but experts put it in second place. Delving deeper into the content analysis of the latest situation around it, one can see additional arguments in favor of its relevance. They may be related to the prospect of routing a much larger linear transportation project – bringing the Moscow-Kazan-Yekaterinburg high-speed highway to the Urals just through the south of the Perm region, via Chernushka. In this case, Chernushka is likely to become a transportation hub, from which lines will be needed both to the north, toward Perm and Solikamsk, and to the south, to Bashkiria.

With the help of the simulation expert model, the uncertainty in the assessment of the subsequent similar, including relatively unextended links between the regions of the Greater Urals is reduced.

Conclusion

At present, due to the sanctions period affecting the delivery of goods, the development of the transport rail network is a particularly urgent issue. Due to the turbulence of economic processes in this period, decisions must be made that are effective, first and foremost, from a nationwide perspective. For this purpose, it is necessary to justify them taking into account multi-criteria and all available information, which at the initial stages is fundamentally incomplete, insufficiently reliable and sometimes weakly formalized. In such cases, it is advisable to use special methods that allow evaluating decisions under conditions of uncertainty, in particular methods of fuzzy logic and mathematics.

With the help of fuzzy logic methods, it is possible to find compromise options that satisfy the various interests of those affecting the decisions, regardless of the structural organization of the backbone industries, one of which is undoubtedly the transport industry.

An important conclusion of our study is that by including the most significant technological

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and economic criteria, reflecting the national priority, the order of priority of transport rail support on the most important in the federal and regional scale main lines was assessed.

In accordance with the objectives of this study, the article implements a process of pairwise comparison of elements of sets (projects and criteria) based on the most significant technological and economic requirements, reflecting the nationwide priority. The formalized procedure of fuzzy multi-criteria analysis applied to comparison of different ways of priority of constructions of the main railway lines directions enabled to estimate the priority of transport railway provision on the investigated most important in federal and regional scale main lines. The best project out of all those considered, which satisfies all the criteria considered, is the continuation of the Middle Ural Latitudinal Railway on the N.-Tagil – Perm section.

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The role of Russian border regions in the cross-border cooperation between Russia and Kazakhstan

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ABSTRACT
Relevance. In the attempt to withstand sanctions pressure and the continuing decline in the relationships with European states, the Russian government has switched the focus of its foreign economic policy to the south-eastern partners, including Kazakhstan.
Research objective. The study aims to evaluate the readiness of the Russian border regions for more active cross-border cooperation with regions of Kazakhstan; to draw an inventory of the main forms such cooperation can take; and to describe the prospects of this cooperation in the context of the increasing integration processes in border regions.
Data and methods. The article compares the dynamics of socio-economic indicators and qualitative characteristics of Russian border regions and summarizes the experience of cooperation between Russian and Kazakhstani border regions. The study relies on the methods of systems analysis and comparative analysis and uses the official data of regional Kazakhstani and Russian governments on the socio-economic development of their territories. The study also uses the statistical data provided by the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the Federal State Statistics Service of the Russian Federation (Rosstat).
Results. The study has brought to light significant disparities in Russian border regions' socio-economic potential, more specifically, in their readiness to participate in the integration processes with regions of the neighbouring state. The proposed conceptual model of cross-border cooperation comprises three levels: transport communication, joint projects, and social services. This model underpins the typology of Russian border regions, highlighting the most promising areas for their cooperation with Kazakhstan and the main impediments to such cooperation. By applying this model, we have identified the main growth points and bottlenecks in interregional cooperation along the state border and described the key trends in the development of the given countries in the context of global risks.
Conclusions. The cross-border cooperation model can provide a framework for the development of projects aimed at enhancing the productivity of the relationships between the two countries. These findings may be used to evaluate the readiness of border regions to establish productive, mutually beneficial relationships with regions of the neighbouring state. They may also be of interest to policy-makers, national and regional government agencies.

KEYWORDS
Russia-Kazakhstan border, border regions, cross-border cooperation, economic potential of a territory, economic profile of a region, cluster

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Роль приграничных российских регионов в сотрудничестве России и Казахстана

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АННОТАЦИЯ
Актуальность. Пытаясь противостоять санкционному давлению и продолжающемуся ухудшению отношений с европейскими государствами, российское правительство переключило фокус своей внешнеэкономической политики на юго-восточных партнеров, включая Казахстан.
Цель исследования. Исследование направлено на оценку готовности приграничных регионов России к более активному сотрудничеству с регионами Казахстана, проведение инвентаризации основных форм такого

КЛЮЧЕВЫЕ СЛОВА
российско-казахстанская граница, приграничные регионы, трансграничное сотрудничество, экономический потенциал территории, экономический профиль региона, кластер количество

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сотрудничества и описание перспектив этого сотрудничества в контексте усиливающихся интеграционных процессов в приграничных регионах.
Данные и методы. В статье на основе сопоставления рядов динамики социально-экономических показателей и качественных характеристик обобщен опыт взаимодействия приграничных регионов России и Казахстана. В исследовании использованы методы системного и сравнительного анализа, Обобщены данные социально-экономического развития приграничных областей России и Казахстана с официальных сайтов регионов. Исследование опирается также на статистические данные, предоставленные Бюро национальной статистики Агентства по стратегическому планированию и реформам Республики Казахстан и Росстатом.
Результаты. Исследование выявило заметную неравномерность в социально-экономическом потенциале приграничных с Казахстаном регионов страны, их готовности участвовать в интеграционных процессах с регионами соседнего государства. Представлена концептуальная модель организации приграничного сотрудничества, в соответствии с которой выделены три уровня – транспортное сообщение, совместные проекты и социальное обслуживание населения, представлена типологизация приграничных регионов России, определены перспективные направления сотрудничества с регионами Казахстана, выделены ключевые проблемы. Выявлены точки роста и узкие места в осуществлении межрегионального сотрудничества по всей линии государственной границы, описаны тенденции развития стран в условиях глобальных рисков
Выводы. Модель трансграничного сотрудничества может стать основой для разработки проектов, направленных на повышение продуктивности отношений между двумя странами. Эти данные могут быть использованы для оценки готовности приграничных регионов к налаживанию продуктивных взаимовыгодных отношений с регионами соседнего государства. Они также могут представлять интерес для лиц, определяющих политику, национальных и региональных государственных органов.

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俄罗斯边境地区在俄罗斯-哈萨克斯坦合作中的作用

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摘要
现实性：为了对抗制裁压力和与欧洲国家关系的持续恶化，俄罗斯政府已将其对外经济政策重点转移到包括哈萨克斯坦在内的东南部伙伴。
研究目标：该研究旨在评估俄罗斯边境地区是否准备好与哈萨克斯坦地区进行更积极的合作，对这种合作的主要形式进行盘点。并描述边境地区一体化进程背景下这种合作的前景。
数据和方法：文章在比较社会经济指标的一系列动态和质量特征的基础上，总结了俄罗斯和哈萨克斯坦边境地区的互动经验。本研究采用系统和比较分析法，总结了俄罗斯和哈萨克斯坦边境地区官方网站上的社会经济发展数据。本研究还基于哈萨克斯坦战略规划和改革署国家统计局、俄罗斯统计局提供的统计数据。
研究结果；该研究显示，俄罗斯与哈萨克斯坦接壤地区在社会经济潜力和参与一体化进程的意愿方面存在明显的不平衡。文章提出了跨境合作组织的概念模型，并根据该模型区分了三个层次——交通运输、联合项目和社会服务。文章还介绍了俄罗斯边境地区的类型，确定了与哈萨克斯坦有希望合作的领域，并指出了合作关键问题。另外，本文还确定了实施跨国家边境区域间合作的增长点和瓶颈，描述了全球风险背景下的国家发展趋势。
结论：跨界合作模式可以成为提高两国合作效率的基础。文章的数据可以用来评估边境地区是否已准备好与邻国建立富有成效的互利关系。政策制定者、国家和地区政府也可能对它们感兴趣。

关键词
俄哈边境、边境地区、跨境合作、领土经济潜力、区域经济概况、集群数量

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Introduction

The social turbulence in Kazakhstan in January 2022 and the worldwide upsurge in social tensions caused by Russia's actions in Ukraine increased public awareness of national security issues, the most important of which is the country's ability to eliminate possible threats by reinforcing its borders and stimulating cross-border cooperation. In view of the current situation, a special focus should be made on the 7,598.8 kilometre stretch of the border separating Russia from Kazakhstan. The Russia-Kazakhstan border is almost totally a land border, except for 1,516.7 km of the river border, 60 km of the lake border, and 85,8 km of the border that goes across the sea. Russia has 12 regions bordering with Kazakhstan, including Samara region, whose southernmost tip – settlement Koshkin of Bolshechernigovsky District – lies on the border with Kazakhstan. Kazakhstan has 7 regions bordering with Russia (Golunov, 2005). Territories on the Russian side of the border are inhabited by about 26 million people, including 3 million in the regions lying in close proximity to the Russia-Kazakhstan border; on Kazakhstan's side, there are 5.8 million people, including over 2 million in border areas (Zhusupova, 2012).

There is a view that disparities in the qualify of life in border regions of the neighbouring states create severe pressures on the areas with a more developed infrastructure (Florinskaya, 2003). Moreover, while municipal authorities in border areas bear full responsibility for the situation in these areas, the establishment of cross-border cooperation falls under the competence of the federal government (Arsentieva, 2012).

Theoretical framework

Relationships between border areas is an important problem for many countries. In Russia this problem is particularly relevant for those territories that acquired the status of border regions after the collapse of the USSR (Vardomsky, 2015). In Europe a special interregional cooperation programme, co-funded by the European Union, was launched in 1990. This program called Interreg was aimed at creating conditions for more effective cross-border cooperation. In 2014, the program was updated, resulting in its current version – Interreg V, which comprises three types of subprograms: cross-border, transnational, and interregional cooperation. The largest amount of EU budget funds goes to the cross-border programs, which include a range of smaller-scale projects targeted at creating cross-border socio-economic ties (Kuznetsov, 2019; Kondratieva, 2020).

In the situation of the fully open internal borders within the EU, the Interreg program has contributed to more intensive cooperation of public authorities and people living in border areas, resulting in new forms of cross-border relationships. Anke Strüver in her study on the Dutch–German borderland (2005) explains that due to a housing shortage in the Netherlands, Dutch people have recently begun to move to German places directly on the border while retaining their jobs in the Netherlands. This has led to the emergence of a community of transmigrants.

As a result of the Interreg program, territories of varying levels of socio-economic development were integrated into the system of interregional socio-economic relationships. The program has also stimulated collaborative projects, facilitated intergovernmental decision-making procedures for the improvement of life quality in borderlands.

Kazakhstan is one of Russia's key strategic partners, the centre of Eurasian integration, a large exporter and importer of goods and services from and to Russia. There is no doubting the fact, however, that at the moment neither of the countries fully benefits from their proximity to each other and realizes the strategic potential of the existing socio-economic systems. There is also growing competition surrounding the promotion and realization of investment projects in Central Asian countries, among which Kazakhstan occupies the leading place (Petrov, 2022; Mukhtarova, 2021). If we look at the indicators of small entrepreneurship development in 2011–2018, we will see that the role of Russian and Kazakhstani border regions did not change much, which increases the prospects of cross-border cooperation (Doroshenko, 2020). Transport infrastructure and tourism are now becoming increasingly important for the development of border regions (Doroshenko, 2021), which means that neighbouring states need to join their efforts to build a balanced cooperation policy.

In light of the above, the following questions arise: how ready are the border regions of Kazakhstan and Russia for large-scale economic cooperation? Which spheres hold the most promise in this respect, and what forms can such cooperation take?

A distinguishing feature of the Russia-Kazakhstan border is that it appeared as a result of the dissolution of the USSR, which resulted in ra-

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dically new conditions for the demarcation or delineation of the borders of the newly independent states [Mayevsky 2018]. After Russia and Kazakhstan joined the EuroAsian Economic Community (EurAsEC) and in 2015, the Eurasian Economic Unity (EAEU), there was a marked increase in both sides' interest in cross-border cooperation and integration of their border areas.

Contemporary research literature describes two main aspects of cross-border integration:

1. Political-geographical: the influence of national borders on political and economic relations between the neighbouring countries;

2. Socio-economic: the influence of national borders on the relationships between areas and regions

From the economic perspective, the second aspect is of special interest because it can be used to differentiate border areas and build a model to examine the interconnections between them (Wróblewski, 2020, p. 112).

The European case of cross-border cooperation as part of the Interreger initiative can provide us with some valuable insights into how regions' ability to participate in cross-border cooperation can be evaluated. Depending on the degree of transparency of the national border and the relationship between the neighbouring countries, Italian scholar Raimondo Strassoldo in 1974 proposed a typology of border regions – frontier regions, peripheral regions, bridge regions, and hinge regions. Frontier regions are mostly found in young states that manifest expansionist tendencies and, therefore, heavily depend on internal resources for their development. In peripheral regions, business activity is shifted from the border to the centre because of the more impenetrable state borders. Bridge regions, as their name suggests, are located along partially open borders and therefore act as bridges for the neighbouring states, facilitating the exchange of goods and the movement of people. Hinge regions have much more intensive cross-border interactions than bridge regions. As a result, borderland communities merge, forming territorial entities (Strassoldo, 1974).

There are, however, significant disparities in Russian regions' ability to participate in cross-border cooperation with their Kazakhstani counterparts, which makes them particularly interesting for research. This study also aims to identify the possible forms of cross-cooperation and describe its prospects in the light of the intensifying integration processes.

The main research goals this study intends to address are as follows:

– to evaluate the socio-economic potential of Russian and Kazakhstani border regions and to outline the most promising areas of cross-border cooperation between the two countries;

– to build a conceptual model for the evaluation of Russian border regions in terms of their readiness for socio-economic cooperation with Kazakhstan;

– to develop a typology of Russian border regions in accordance with the criteria included into the model and evaluate the compatibility of the economic potential of Russia and Kazakhstan in the context of their current socio-economic ties.

Data and methods

The study uses the method of comparative analysis to identify the most promising areas of cross-border cooperation between Russia and Kazakhstan, the spatial channels of trade exchange, and the social factors that are conducive to such exchange or, on the contrary, impede it.

For mutually beneficial cross-border relationships, it is necessary that border regions should maximize their economic potential. Within the existing approaches to the study of regional socio-economic potential, a set of parameters are used to evaluate a given region's ability to actively participate in establishing and maintaining cross-border cooperation. These parameters include natural conditions, the demographic situation, labour resources, industrial specialization, exports, infrastructure, and some others (Nikulina, 2012; Dabiev, 2019). Song proposes three indices to evaluate the potential of a border area: local economy, export-oriented economy, and local development (Song, 2017).

Analysis of different approaches to the evaluation of regional socio-economic potential has shown that there is a set of commonly used parameters, which are also applicable for the evaluation of a border region. These parameters reflect the comparative characteristics of a given region in relation to its neighbour on the other side of the border. The most significant parameters include the following: population size (density), gross domestic (regional) product, industrial specialization, per capita income, fixed capital investment, and percentage of the population comprised of the neighbouring country's titular nationality. All of these parameters to a varying degree reflect the human potential of the given territory, its material and financial

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resources as well as its readiness to establish social connections with the neighbouring territories. In my previous studies I have already conducted comparative analysis of Omsk region (Russia), Pavlodar region (Kazakhstan) and East Kazakhstan (for more on the research methodology, challenges and prospects identified, see: Roy, 2022)

This study focuses on 7 border regions in Kazakhstan and 12 in Russia, which are analyzed according to the above-described parameters. The analysis aims to shed light on the areas of common interest for the neighbouring regions and to build a model for organizing cross-border cooperation between Russia and Kazakhstan. The model is based on three key areas of cross-border cooperation, which are specified in the agreements between the two countries. The levels of the model are determined through qualitative analysis of documents, intergovernmental agreements, and the results of the survey of the officials participating in the development of foreign trade policy of some Russian regions.

Results

Economic potential of Kazakhstan's border regions

Kazakhstan has a long border: in fact, 12 out of its 14 administrative regions and 79 out of 168 districts are located along the border. 12% of the country's population live in areas bordering Russia; 7%, Uzbekistan; and 6%, Kyrgyzstan (Fig. 1). Overall, most of the Republic's population (73%) is concentrated in border areas. Interestingly, a third of them live in administrative regions that are located in the immediate vicinity of the border (Golunov 2006, p. 114).

Figure 1. *Border regions of the Republic of Kazakhstan*
Source: http://www.stokart.ru/index/kazakstan/kazakstan_276.html (accessed: 14.06.2022)

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Kazakhstan benefits from its location in the center of the Eurasian continent by building strong trade links with 170 countries. The largest trade partners for Kazakhstan are Russia (its share in Kazakhstan's international trade is almost 22%), China (18%), Italy and South Korea (8.9% and 6.9% respectively), the Netherlands, Turkey, Uzbekistan, France, India, and Germany (2.4–4%). According to the World Bank, the share of foreign trade in Kazakhstan's GDP structure is over 60%[1].

Even though Kazakhstan is primarily a natural resource-based economy (Kazakhstan's exports include oil, gas, ore, wheat, copper and copper cathodes, uranium, rolled steel products, oil products and unwrought zinc), the country is now actively developing its manufacturing industry (Aubakirova, 2021). The main imports from Russia are machinery, equipment and transport, instruments and appliances, consumer goods, chemicals, wood and wood products, food and agricultural products. Nevertheless, in the cooperation between Russia and Kazakhstan there is still room for improvement: in 2019–2020, Kazakhstan ranked only 10th among Russia's largest trade partners[2].

Even though Russia is one of Kazakhstan's largest trade partners, the share of Russian investment in Kazakhstan's economy is not very significant. According to the National Bank of Kazakhstan, the amount of foreign direct investment (FDI) in Kazakhstan from Russia and China is estimated as $4.8 billion and $5.2 billion respectively while for the Netherlands this figure is much more impressive: $60 billion out of $152.8 billion, with the USA ranking second – $39.5 billion. The latter fact can be explained by the substantial investments made by American companies into the oil and gas sector of Kazakhstan[3].

There are significant disparities in the spatial distribution of the Republic's export potential: four regions account for almost 70% of all the export flows. These include Atyrau and Karaganda regions (18–20% each) and the cities of Almaty and Astana (23% and 6% respectively). Most businesses supply their products either to customers in their own regions or to the neighbouring regions: only 2% of enterprises export their products to foreign markets[4]. One of the most efficient ways to improve the country's exports is cluster policy aimed at unlocking regions' potential (Turgel, 2020).

The uneven distribution of productive forces across Kazakhstan's territory correlates with the significant disparities in the average population density. The regions located along the border with Russia, for example, Pavlodar region, have population density of 6.1 people per sq.km or less than that. In the western part of the country – in Aktobe region – this figure is as low as 2.7 people per sq.km. The least densely populated territories are the mountainous areas of East Kazakhstan and the western parts of Atyrau region, where the population density is about 2 people per sq.km[5]. In Russian border regions similar levels of population density are found only in the Altai Republic (2.3 people per sq.km) while in the majority of regions these figures exceed the level of 10 people per sq.km. (Karpenko 2019, p. 25).

Table 1 shows the comparative analysis of the key socio-economic indicators of Kazakhstan's border regions, leading us to some important conclusions.

In general, Atyrau region, which is the centre of the Republic's oil production, is the top-scorer among Kazakhstan's border regions in the indicators of socio-economic development. The region is abundant in oil fields such as Tengiz, Dauletaly, Zhana Makat, Borkildakty, and Vostochno-Tegenskoye. West Kazakhstan region also demonstrates a relatively high level of economic performance. East Kazakhstan and Aktobe regions are dynamically developing territories with vast potential reflected in their higher GRP levels and higher fixed capital investment. Despite the comparatively low population density in Atyrau Region, its population growth rate is quite high: from 432.9 thousand people in 1990 it rose to 657.1 thousand people in 2020. West Kazakhstan has a somewhat slow population growth in

[1] FYI from Rossiyskaya gazeta: Kazakhstan's Economy and its Connection with Russia. 06.01.2022 Available at: https://rg.ru/2022/01/06/spravka-rg-ekonomika-kazahstana-i-ee-sviaz-s-rossiej.html (accessed: 14.06.2022).

[2] International trade of Russia. Available at: https://russian-trade.com/reports-and-reviews/2021-02/torgovlya-mezhdu-rossiey-i-kazahstanom-v- (accessed: 14.06.2022).

[3] Tkachev I. Which Countries Most Affect Kazakhstan's economy. What is Important to Know. Available at: https://www.rbc.ru/economics/12/01/2022/61dc3c029a79474999203b91 (accessed: 14.06.2022).

[4] Background info from Rossiyskaya gazeta: Kazakhstan's Economy and its Connection with Russia. 06.01.2022 Available at: https://rg.ru/2022/01/06/spravka-rg-ekonomika-kazahstana-i-ee-sviaz-s-rossiej.html? (accessed: 14.06.2022).

[5] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (by branch). Available at: https://stat.gov.kz/official/industry/139/statistic/6 (accessed: 14.06.2022).

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the similar period: its population increased only by 10 thousand people. In Aktobe region, the population grew from 740 thousand people to 894.3 thousand. Other border regions are facing a demographic decline: in Kostanay region, for example, the population shrank sharply from 1239.1 thousand people in 1991 to 864.5 thousand in 2020; in Pavlodar region, from 956 thousand to 747 thousand, in North Kazakhstan, from 917.9 thousand to 543,7 thousand; in East Kazakhstan, from 1777.3 thousand to 1363.8 thousand[6]. Migration has a serious impact on the distribution of investment potential and reflects the changes in the local economic situation (Bokaev 2021, Kireyeva 2022).

An important demographic trend is the growing number of Kazakhs as the titular ethnic group in most of the Republic's border areas. The degree of concentration of non-titular ethnic groups in border areas is an important factor for the organization of cross-border cooperation. For a long time, the Russians made up the majority of the population in urban areas of Kazakhstan while most of the inhabitants of rural areas were Kazakh. In the 1970s and 1980s, the processes of urbanization in Kazakhstan intensified (Alekseenko, 2021), although they were less pronounced in the north-eastern parts of the Republic. In North Kazakhstan, Russians are a majority group while in Kostanay region, the proportions of the Russian and Kazakh population are almost equal.

One of the possible ways of tackling the negative impacts of the crisis could be to stimulate cross-border trade. At the moment Kazakhstan's government is making plans for creating trade hubs on the territory of West Kazakhstan and North Kazakhstan. The new law "On Industrial Policy" will describe a mechanism for subsidizing the financing rate to incentivize foreign customers for Kazakhstan-produced goods and services. Another draft law that is being discussed at the moment is "On the Export-Credit Agency of the Republic of Kazakhstan", which will introduce a single window principle for export-oriented enterprises. Online portal *export.gov.kz* will be turned into a single window – Digital Export – and used to consolidate all measures of state support for Kazakhstani exporters[7].

The possible moves towards further integration between Russian and Kazakhstani regions (based on the prior agreements and the Russian government's decision to legalize parallel imports following the announcement of the sanctions against Russia in March 2022) make Kazakhstan's role in this process substantially more significant and open up new horizons for trade between the two countries, including their border regions.

To stimulate cross-border cooperation, it is necessary to expand the transport network, increasing the amount of goods and services sold to European and Russian markets (Pak 2020). The total road network size in Kazakhstan is 157 thousand kilometres, including 25 thousand km of state roads and 71 thousand km of regional and local roads. According to the official data, Mangystau region has the best roads (94%) and the worst

[6] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (by branch): Available at: https://stat.gov.kz/official/industry/139/statistic/6 (accessed: 14.06.2022).

[7] Trade Hubs to be Created on the Border with Russia. Available at: https://kapital.kz/economic/93271/torgovyye-khaby-sozdadut-na-granitse-s-rossiyey.html (accessed: 14.06.2022).

Table 1

Comparative analysis of Kazakhstan's border regions, key socio-economic indicators

Region	Population, ths people	GDP per capita, ths tenge	Average monthly salary, tenge	Ratio of Kazakhs to Russians, ths people	Fixed capital investment and investment in manufacturing, mln tenge
Aktobe	907.6	3329.8	244,619	749.2/96.0	648,036
Atyrau	668,2	11970.8	420,415	610.1/32.9	3,330,847
West Kazakhstan	666.0	41522.0	240,703	511.1/122.3	481,485
Kostanay	857, 4	3314.5	225,172	357.6/353.6	288,112
Pavlodar	747, 1	2801.4	246,299	399.1/262.6	592,849
North Kazakhstan	536, 4	2877.7	202,983	193.6/278.8	286,251.5
East Kazakhstan	1356,4	3460.4	250,976	836.5/486.9	729,115

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (by branch). Available at: https://stat.gov.kz/official/industry/139/statistic/6 (accessed: 14.06.2022).

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roads are in West Kazakhstan region (34%)[8]. Improvement of the state of the road network in border areas should become one of the priorities in cross-border cooperation development.

Development of the economic potential of Russian border regions

Russian regions along the border with Kazakhstan include Astrakhan, Volgograd, Saratov, Samara, Orenburg, Chelyabinsk, Tyumen, Omsk, Novosibirsk, Kurgan, Altai regions and the Altai Republic.

Table 2 shows the analysis of the key socio-economic indicators of Russia's border regions.

In addition, let us compare the economic profiles of Russian border regions reflecting their business and trade ties with Kazakhstan. The economic profile of a border region shows its base specialization, that is, the sector(s) of the regional economy with the largest share in the trade turnover; the role played by the neighbouring country in the region's international trade relationships; and the total volume of the region's trade with the neighbouring country in terms of the exports/imports structure.

The data shown in Tables 2 and 3 leads us to the conclusion that Russia's Siberian and Ural regions have the closest ties with Kazakhstan. Even though Kemerovo region does not share a border with Kazakhstan, this region has the highest proportion of trade turnover with this country, mostly coal exports. Another leader in terms of cross-border cooperation with Kazakshtan is Chelyabinsk region, whose foreign trade turnover is almost 2 billion dollars.

Another large trade partner for Kazakhstan is Orenburg region, bordering West Kazakhstan and Aktobe regions. Orenburg region accounts for over 10% of Russia's trade with Kazakhstan (Yermakova 2018, pp. 1252–1253).

Novosibirsk region has been Kazakhstan's long-standing trade partner with traditionally large volumes of exports to this country, including electric engines, heating furnaces, industrial fans, agricultural equipments, tools, and health care products[9]. Novosibirsk region ranks second after Kemerovo region in the Siberian Federal District in terms of exports. Interestingly, Kazakhstan accounts for only 11.3% of the total foreign trade turnover of Novosibirsk region, which is lower than the share of other trade partners, for example, China (29.7%) and even France (12.2%).

Even though the border between Samara region and Kazakhstan is only several hundred meters and there is no border checkpoint, the trade between this region and Kazakhstani partners is rather intensive.

[8] The roads in Kazakhstan that we are being offered. Available at: https://ia-centr.ru/publications/kazakhstanskie-dorogi-kotorye-nam-predlagayut/ (accessed: 14.06.2022).

[9] Kuznetsova T. What Siberian Regions Export to Kazakhstan. Available at: https://rg.ru/2019/11/06/reg-sibfo/chto-eksportiruiut-sibirskie-regiony-v-kazahstan.html (accessed: 14.06.2022).

Table 2

Comparative analysis of Russia's border regions, key socio-economic indicators

Region	Area ths sq.km.	Population, ths people	GRP per capita, rus	Fixed capital investment, bln rbs	Per capita income (per month, rbs)	Ratio of Russians to Kazakhs, % (Census of 2010)
Altai region	168	2296.4	271,319.7	121.8	23864	93.9/0.3
Altai Republic	92.9	221	266,968	13.3	21,677	56.6/6.2
Astrakhan	49	998	596,388.2	111.6	25,199	67.6/16.3
Volgograd	112.9	2474.6	384,677.3	189.9	24,864	90/1.8
Kurgan	71.5	818.6	280,971.3	40.0	21,860	92.5/1.3
Novosibirsk	177.8	2785.8	504,043.1	263.9	31,563	95/0.3
Omsk	141.1	1903.7	399,371.1	210.5	27,354	85.8/4.1
Orenburg	123.7	1942.9	564,897.9	199.0	24,719	75.9/6.0
Samara	53,.6	3154.2	535,127.7	278.5	29,893	85.6/0.5
Saratov	101.2	2395.1	333,876,	167.2	24,046	87.5/3.0
Tyumen region (without autonomous districts)	160.1	1543,4	813,463	293.4	31,151	73.3/0.6
Chelyabinsk	88.5	3442.8	445,276.7	322.2	26,628	83.8/1.0

Source: Regions of Russia. Socio-Economic Indicators. 2021: Statistical Yearbook. Rosstat. Moscow, 2021. 1112 p.

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Nevertheless, some Russian border regions are obviously failing to realize their potential for trade with Kazakhstan: for example, in 2019 Kazakhstan ranked only 11th in the list of Astrakhan region's partners in terms of the total trade turnover. Quite insignificant also seems the volume of trade with Kazakhstan for Tyumen region and the Altai Republic[10].

Even though both countries are members of the EAEU, their border is not easy to cross. There are 51 registered checkpoints, including 30 road checkpoints, 20 railroad checkpoints, and 1 river checkpoint. The main impediments to cross-border movement is the inefficiency of the checkpoints, red tape and lack of information about the formalities and procedures. The settlements along the border are usually quite small in size and are incapable of taking any advantage of their location. All the decisions concerning border crossing are taken by government bodies whose offices are located in the administrative centres of border regions.

The majority of settlements located in close proximity to the border carry out transactions with the territories inside the country, mostly administrative regional centres. Local authorities of such settlements do not gain any advantages from their location, on the contrary, they have to bear the costs of dealing with the regular flow of illegal goods trafficking.

It should be noted that big cities in Russia's and Kazakhstan's border regions are separated by large distances (see Table 4). Big cities are crucial for the stimulation of cross-border trade since they have most of the manufacturing enterprises and serve as markets for exported goods and services.

[10] Analysis of the volume and structure of Russian border regions' trade with Kazakhstan in 2019. Available at: https://kaztrade.ru/uploads/files/2020/04/23/2019-tovarooborot-s-regionami-rossii_1587634076.pdf?ysclid=l12y50n47g (accessed: 14.06.2022).

Table 3

Economic profiles of Russian border regions (key sectors, trade statistics, the role of Kazakhstan)

Region	Economic specialization (sectors of the regional economy with the largest shares in the region's turnover)	Kazakhstan's position in the ranking of trade partners (by volume of trade turnover)	Share of Kazakhstan in the region's foreign trade turnover, %	Foreign trade turnover, mln dollars	Export, mln dollars	Import, mln dollars
Altai region	Mineral commodities (29%), machinery, equipment, and tools (12%)	1	30.8	430.5	339.18	91.33
Altai Republic	Plant products (52%), animal products (18%)	1	30	20.1	17.3	2.8
Astrakhan	Animal products (27%), food, beverages and tobacco (14%)	11	1.3	12.7	8.9	3.8
Volgograd	Metals and products thereof (27%), chemicals (22%)	6	5,.4	134.6	118.9	15.7
Kurgan	Plant products (46%), metals and products thereof (15%)	1	33	85.65	48.49	37.16
Novosibirsk	Metals and products thereof (34%), machinery, equipment and tools (12%)	3	11.3	600.7	393.8	206.9
Omsk	Machinery, equipment and tools (26%), food, beverages and tobacco (13%)	1	30	343,.2	229	114.1
Orenburg	Mineral commodities (46%), metals and products thereof (12%)	1	14	364.6	302	62.6
Samara	Transport (25%), machinery, equipment and tools (16%)	4	6.3	389.12	352.53	36.6
Saratov	Metals and products thereof (26%), machinery, equipment and tools (19%)	2	10	196.2	162	34
Tyumen region (without autonomous districts)	Plastics and rubber (32%), metals and products thereof (17%)	10	3.5	71.8	53.6	18.2
Chelyabinsk	Mineral commodities (50%), metals and products thereof (29%)	1	10.6	1700.1	833.62	875.29

Sources: Statistics of Russia's international trade: online analysis. Available at: https://statimex.ru/statistic/all/oborot/2015-2020/KZ/ (accessed: 14.06.2022); Exports and imports of Russia, by commodity groups and countries. All commodity groups, July 2020-April 2021. Available at: https://ru-stat.com/date-M202101-202109/RU75000/trade/KZ? (accessed: 14.06.2022).

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Table 4

Minimum distances between border cities of Russia and Kazakhstan

Cities in Kazakhstan	Cities in Russia	Distance, km
Atyrau	Astrakhan	366
Aktobe	Novotroitsk, Orsk	182,176
Kostanay	Chelyabinsk, Kurgan	319,315
Petropavlovsk	Kurgan, Omsk	272,288
Uralsk	Novokuybyshevsk, Samara, Orenburg	260,263,285
Semipalatinsk (Semey)	Rubtsovsk	160
Ust-Kamenogorsk	Rubtsovsk	277

Source: Portal Avtodispetcher. Distances between Cities in Kazakhstan. Available at: https://www.avtodispetcher.ru/distance/table/c214665-kazakhstan/ (accessed: 22.09.2022).

Saratov and Volgograd are located remotely from cities in Kazakhstan: for example, the distance between Saratov and the Kazakhstani city of Uralsk, which is the closest to the border, is 420 km; between Uralsk and Volgograd, 793 km. Thus, large distances impede interregional integration that could be conducive to cross-border cooperation.

Many Russian border regions share similar economic specialization, which could also be useful for stimulating the cooperation between the two countries. For instance, Kurgan region is seen by Kazakhstani partners primarily as an exporter of machinery, equipment, transport vehicles and wood; Novosibirsk region, as an exporter of electrical machinery and equipment, inorganic chemicals; Omsk region, as an exporter of engineering products, petrochemicals, food products and so on.

The comparison of Russian and Kazakhstani border regions and their economic specialization shows a high degree of similarity between the industrial structure of the neighbouring regions. In some cases, new specializations of this or that region may be of particular interest to its neighbour across the border. Long-standing areas of cooperation are oil extraction and processing, chemical production and heavy engineering, metal production, and agriculture. Such spheres as electronics manufacturing, food processing, and tourism also hold much promise.

To stimulate the integration of border regions and realize their potential within the EAEU framework, it is necessary to strengthen business ties between the countries and eliminate the barriers preventing such cooperation. The latter include a poor investment climate and the lack of employment opportunities in border regions. These territories generally have low levels of labour mobility and activity. Even though Russia is quite attractive for labour migrants from the former Soviet countries (in 2020, foreign citizens obtained 970 thousand work patents and in 2021, this figure rose to almost 2 million), the percentage of labour migrants from Kazakhstan is still comparatively small. This contrast can be illustrated by the following statistics: between 2020 and 2021, the number of foreign citizens registered by the Russian migration authorities grew from 8,327,024 to 10,616,980 but for Kazakhstan, these figures are much smaller: out of the 2 million work patents issued in 2021 in Russia, Kazakhstan accounted only for 49,862 (to put this figure into perspective, the number of work patents issued to Ukrainian citizens was 375,989)[11].

Stimulation of business activity in border regions will help attract cross-border partners, cut logistics costs and create more jobs in peripheral territories. Nevertheless, national priorities sometimes take precedence over economic benefits. For example, Karachaganak gas-condensate field in West Kazakhstan, which supplied gas to Orenburg oil processing plant, is considered by Kazakhstan's government as a tool of ensuring the country's economic independence from Russia rather than as a foundation for the economic integration with its geo-political neighbour (Vendina, 2016).

11 Migration in 2021. Migrants from which countries were granted Russian citizenship and work permits? Available at: https://sntat.ru/news/migraciya-za-2021-god-vyx-odcy-iz-kakix-stran-polucili-grazdanstvo-rf-i-razreseniya-na-rabotu-5834518 (accessed: 14.06.2022); Indicators of Migration in the Russian Federation in January-December 2021 by countries and regions. Available at: https://xn--b1aew.xn--p1ai/dejatelnost/statistics/migracionnaya/item/28104344/ (accessed: 14.06.2022).

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Model of cross-border cooperation

To stimulate the development of the borderlands in Russia and Kazakhstan, policy-makers should take into account the typology of Russian border regions. This typology highlights their strengths, weaknesses, and industrial specialization – the factors influencing regions' ability to benefit from their export potential and establish mutually beneficial relationships with foreign partners. This typology is based on the special model of cross-border cooperation comprising several levels necessary to ensure the stable reproduction of interregional relationships in the neighbouring countries.

The study conducted by the Laboratory of Regional and Strategic Studies of Omsk State University n.a. F.M. Dostoevsky has shown that there are three main factors that determine the key areas for cross-border cooperation. These areas can be also considered as the three key levels for the model of cross-border cooperation*: transport communication, joint projects,* and *social services* (Fig. 2). The choice of these levels is determined by the role they play in the establishment of intergovernmental agreements. In other words, they reflect the areas of mutual interest. Consecutive movement through these levels can be used as an algorithm for the creation of the cross-border cooperation system.

This study has brought to light the connection between transport infrastructure and the volume of trade in border regions, the role of each region's economic specialization in building mutually beneficial relationships with the neighbours. The key to productive cross-border cooperation is transport communication between the border areas, e.g. road and railway connections between the border areas, roadside infrastructure.

The second level of the model – joint projects – make interregional interactions more economically meaningful, satisfying each side's demands in the situations where, for example, joint effort is needed: this applies particularly to capital- and labour-intensive deposit development projects, which require the utilization of the full capacity of transport communications and processing plants.

The third level of the model – social services – is based on the common interests of people inhabiting borderlands, their right to have access to social services on both sides of the border. The most essential social services include health care, education, leisure, recreation, tourism, etc. On the one hand, the proposed model imitates the structure of cross-border cooperation and, on the other, it highlights the key points along the whole Russia-Kazakhstan border that are capable of providing a solid foundation for further development of cross-border relationships. Each of the higher levels of the model relies on the lower levels for its development. Thus, in its entirety, the model represents a consistent and complete system of cross-border cooperation. In case this or that level of the model is absent for a certain region, efforts should be made to address this gap and complete the logical structure.

In accordance with the above-described levels, the following criteria for the typology of Russian border regions can be identified.

Developed transport infrastructure is the key criterion for the typology of Russian regions in terms of cross-border cooperation with Kazakhstan. By applying this criterion, we can divide Russian border regions into five types depending on their ability to ensure productive cooperation with the regions on the other side of the border at the intersection of transport corridors.

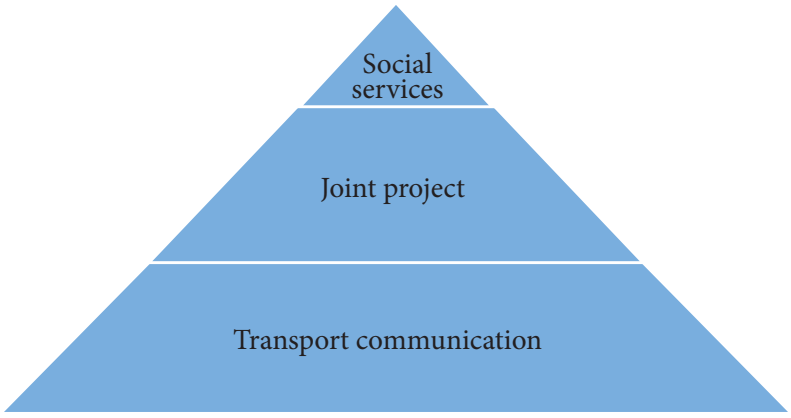

Figure 2. *Conceptual model of cross-border interactions*
Source: compiled by the author

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1. Orenburg region. It is planned to build a transport corridor between China and Western Europe going via Kazakhstan and Russia. This corridor will cross the territory of Aktobe and Orenburg regions and contribute to the development of the road infrastructure and trade relationships between all the participants of the project. It will also help enhance the road surface quality in West Kazakhstan and encourage other neighbouring regions to cooperate with their Russian counterparts.

2. Novosibirsk region. At the moment this region is the largest transshipment hub where cargo transported to and from Kazakhstan is redistributed (Chernobay, 2015). The most important role is played by the railway hub, which is the largest in Siberia, and the marshalling hub located next to the airport, capable of processing large amounts of postage.

3. Omsk region. It is planned to create a full-scale transport and logistics centre in the region, including an airport, highway, railroad, river port, oil pipeline, industrial business park, customs terminals, exhibition centre, and other objects of infrastructure. All of the above is expected to provide a foundation for the creation of a meridional route connecting countries of Central Asia with regions of the North and the Arctic as well as with the European part of the country. To address this goal, project 'Meridian 73' has been developed. In the long run, it can result in the creation of a new large transport hub between Russia and Kazakhstan (Samokhina, 2017).

4. Samara region. On the border between Samara region and West Kazakhstan, Kazakhstan's government is planning to build the largest logistics hub to ship goods from Kazakhstan to Russia bypassing the border with another country (Abanina, 2021).

5. Astrakhan region. In Astrakhan region, it is planned to create a special port economic zone on the Caspian Sea, which will contribute to the development of the North-South transport corridor (Kryukova, 2019).

At the second level of the model, the main role is played by the regions involved in cross-border cooperation in the sphere of mineral exploration, mine development and mineral processing. The top-scorers on this level are the following regions:

1. Chelyabinsk region. In Chelyabinsk region, most of cross-border cooperation is focused on the development of the Tarutin copper deposit located 28 km south-east of village Chesma in Chelyabinsk region and 75 km west of village Karabalyk in Kostanay region[12]. Chelyabinsk region may be a suitable place for the creation of a large metallurgical cluster specializing on ferrous and non-ferrous metal processing and manufacturing of products for the electronics industry.

2. Altai region. Altai region plays an important role in cross-border cooperation in the sphere of power systems engineering and agricultural processing. Other widely discussed plans include the project to build a gas pipeline along the route Barnaul–Rubtsovsk-Semey–Ust-Kamenogorsk (Oskemen).

One more criterion is the environment, which can be used to evaluate each country's participation in finding cross-border solutions to environmental issues, e.g. concerning the transboundary rivers and lakes. In this respect the relationships between Kazakhstani border regions and Omsk region (River Irtysh), Orenburg region (River Ural), and Astrakhan Region (Caspian Sea) are of utmost importance.

The criterion of social services reflects the neighbouring states' efforts to improve the quality of life in border regions. The most anticipated projects in this field include the creation of a tourist cluster in Altai Region and the Altai Republic; construction of additional objects of social infrastructure, the establishment of a network university and so on (Sidorenko, 2019; Korshunov, 2017; Kuchinova, 2010). To this end, it is necessary to create special funds to ensure that residents of border regions should have access to specific types of social services. In this respect, the EU's experience of providing organised access to cross-border healthcare created alongside the Franco-Belgian border area is of particular interest. The European project enabled the pooling of resources of the two countries so that patients in these health zones could receive care on both sides of the border without any administrative or financial difficulties. Even though the funding allocated to the project was comparatively small (570 thousand euro in 2008–2011), it had a strong impact and popularized this practice in other regions (Kondratieva 2020).

The proposed typology of Russian border regions can be used to evaluate their ability to respond to potential security threats. This typolo-

[12] Copper Ore Border: Russia and Kazakhstan have agreed to develop the Tarutin deposit. Available at: https://www.kommersant.ru/doc/4948523 (accessed: 14.06.2022).

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gy also gives us an idea of the main channels of cross-border cooperation, priority areas in the development of local governance, and ways to improve the cooperation between the two neighbouring states.

Conclusions

Kazakhstan is one of Russia's most important strategic partners, which means that building a productive relationship with Kazakhstan should be a priority for the Russian government. Among other things, it will help mitigate the negative consequences of the sanctions war and help Russia mobilize the necessary resources for the development of its economy. The stretch of the border between Russia and Kazakhstan has now become pivotal for Russia's plans to avoid economic isolation and to strengthen its ties with Asian partners.

The analysis of the socio-economic potential of border regions in Russia and Kazakhstan has brought to light the most promising areas of cross-border cooperation between the countries and laid a foundation for the system of evaluation (conceptual model) of Russian border regions in terms of their readiness for socio-economic cooperation with Kazakhstan. The criteria used in the model also underpin the typology of Russian border regions, aligning the economic potential of Russian border regions with their counterparts in Kazakhstan.

The proposed model can provide a framework for policy-making, project design and implementation aimed at enhancing the productivity of cross-border relationships, incentivizing local governments and borderland communities to participate in cross-border cooperation, and improving the living standards in border regions.

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Territorial distribution of economic activities and resilience in Vicenza's jewelry industry

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ABSTRACT

Relevance. The paper analyzes the development of Vicenza's jewelry industry with a focus on the region's resilience to external shocks and on the role that firms' spatial concentration plays in the way territories respond to crises. The proposed analysis can provide entrepreneurs, managers, and public decision-makers with new insights into how firms' location patterns influence economic development.

Research Objectives. The purpose of this research is to test empirically the correlation between firms' concentration, and resilience to external shocks.

Data and Methods. The study uses the statistical data on the number of employees and active firms within the selected territory provided by Infocamere (Information Society of Italian Trade Chambers) over the last 20 years (2000–2021). These data are used to trace the localization of firms with the help of concentration indexes. By comparing the above-mentioned data, the study tests the correlation between firms' concentration levels, the sector's economic performance, and the reaction of territories to external shocks.

Results. Territories with high concentration levels of firms working in the same sector perform better than other territories. Moreover, territorial concentration increases during and after any adverse external shock. These results are consistent with the research evidence, stressing the relevance of Marshallian-like districts for sharing practices, technology, know-how, access to information, institutional links. These factors, in turn, enhance firms' resilience to external shocks.

Conclusions. The results provide a new understanding of how firms' location schemes can affect sustainable territorial development.

KEYWORDS
industrial districts, resilience, Italian economy, economic history, regional economy, local development, jewelry production, SMEs, entrepreneurship

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Территориальное распределение экономической деятельности и устойчивость ювелирной промышленности Виченцы

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АННОТАЦИЯ

Актуальность. В статье анализируется развитие ювелирной промышленности Виченцы с акцентом на устойчивость региона к внешним потрясениям и на роль пространственной концентрации фирм в реакции территорий на кризисы. Предлагаемый анализ может дать предпринимателям, менеджерам и лицам, принимающим решения, новое понимание того, как схемы размещения фирм влияют на экономическое развитие.

Цель исследования. Целью данного исследования является эмпирическая проверка корреляции между концентрацией фирм и устойчивостью к внешним шокам.

Данные и методы. В исследовании используются статистические данные о количестве сотрудников и активных фирм на выбранной территории, предоставленные Infocamere (Информационное общество итальянских торговых палат) за последние 20 лет (2000-2021). Эти данные используются для отслеживания локализации фирм с помощью индек-

КЛЮЧЕВЫЕ СЛОВА
промышленные районы, устойчивость, итальянская экономика, экономическая история, региональная экономика, местное развитие, ювелирное производство, МСП, предпринимательство

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сов концентрации. Сопоставляя приведенные выше данные, в исследовании проверяется корреляция между уровнями концентрации фирм, экономическими показателями отрасли и реакцией территорий на внешние шоки.
Результаты. Территории с высоким уровнем концентрации фирм, работающих в одном секторе, работают лучше, чем другие территории. Более того, территориальная концентрация возрастает во время и после любого неблагоприятного внешнего шока. Эти результаты согласуются с данными исследований, подчеркивающими актуальность «маршалловых» районов для обмена опытом, технологиями, ноу-хау, доступом к информации, институциональными связями. Эти факторы, в свою очередь, повышают устойчивость компаний к внешним потрясениям.
Выводы. Результаты дают новое понимание того, как схемы размещения фирм могут влиять на устойчивое территориальное развитие.

БЛАГОДАРНОСТИ
Исследование выполнено при поддержке проекта «Экономика превосходства. Итальянское ремесло в международных сетях: традиционные знания, технологические инновации и коммуникационные стратегии (19–20 века)», Университет Падуи (IT), факультет исторических, географических наук и античности.

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维琴察市的经济活动地区分布与珠宝业的可持续性

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摘要
现实性：文章分析了维琴察珠宝行业的发展，重点强调了该地区对外部冲击的恢复能力，以及企业在地区应对危机中的作用。本文可为企业家、管理者和决策者提供新的见解，让他们了解公司的位置分布如何影响经济发展。
研究目标： 本研究的目的是通过实证检验企业集中度与外部冲击恢复力之间的相关性。
数据与方法：该研究使用了Infocamere（意大利商会信息协会）提供的过去20年（2000-2021年）选定地区的雇员和活跃公司的统计数据。这些数据通过集中度指数用来追踪企业的本地化情况。通过比较上述数据，该研究检验了企业集中度水平、行业绩效和地区对外部冲击的反应之间的相关性。
研究结果：公司高度集中的地区比其他地区表现更好。此外，在任何不利外部冲击期及之后，地区集中度会增加。这些结果与强调“马绍尔区”交流经验、技术、知识、信息获取、机构联系的研究相一致。这些因素反过来又增加了公司对外部冲击的抵御能力。
结论：这些结果为企业定位如何影响可持续空间发展提供了新的见解。

关键词
工业区、可持续性、意大利经济、经济史、区域经济、地方发展、珠宝生产、中小企业、创业

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Introduction

Jewelry production in Vicenza boasts centuries-old tradition. Crafts and artisanship emerged in Roman times and, after a period of decline during the Early and High Middle Ages, they came to a revival in the period of the early Italian Renaissance. The foundation of the city's goldsmiths' guild, in 1339, opened a new phase of growth. Vicenza's elegant, refined and high-quality products were exported to major markets, including Venice. The 17th century marked a new turning point in the sector's history, opening an age of almost three centuries-long stagnation. The expansion of textile and then mechanical manufacturing absorbed investments and personnel. Skills, know-how, and tradition, however, were not lost, and constituted the foundation for the new period of growth starting after the Italian unification.

At the end of the 19th century, the sector started to evolve, moving away from manufacturing luxurious, artisan-like jewelry to more affordable items. Mechanization and standardization allowed the creation of medium-quality gold, and silver collections. Local firms successfully targeted larger groups of potential customers. The number of firms as well as the sector's turnover grew

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consistently, and jewelry production emerged again as a key industry of the provincial economy. The number of firms and the sector's turnover grew consistently. This pattern was somehow reproduced in the 1950s, when, after the crisis of the late 1930s and the war, local entrepreneurs further industrialized production processes, taking advantage of the Italian economic boom. At first, they addressed the domestic demand, responding to the needs and fancies of ever larger middles classes. By the 1960s, local entrepreneurs also turned to foreign markets. The United States, Germany andEuropean countries such as France, Holland and England, started buying increasing quantities of Vicenza jewelry. Enlarged production determined both the sector's further expansion and its internal reorganization. Major companies with international clients focused on the strategic knots of the value chain, such as design and marketing, while smaller firms concentrated on niches or worked as subcontractors. Subcontracting, in particular, became structural, which in turn contributed to the emergence of a galaxy of shops specializing in separate stages of the supply chain or in side production and services (Crestanello, 1997). The sector's configuration acquired then the traits of an industrial district (see (Becattini, 1990)).

The above-mentioned trends are mirrored by firms' location. Jewelry production consolidated in Vicenza, the province's capital, in Bassano del Grappa, on the north-eastern side of the province, and in Trissino, in the north-western part (figure 1). The sector became more complex. The above mentioned areas, in particular, developed to some extent autonomously. Vicenza retained its high-level, artisan-like production and merchandizing; Trissino focused on standardization and mechanization; Bassano del Grappa followed hybrid paths, combining traditional jewelry and manufacturing of such items as medals, sports cups, trophies or religious accessories. Apart from the competition, territories also established cooperative relationships. Similar links were established by small and bigger companies. Little shops worked for a few contractors, sometimes just one, but maintained multifaced relationships with other shops. At the time of the peak demand, for example, orders were redistributed among local producers mostly through informal networks built on personal relationships, kinship, and friendship.

In 1951-1971, the sector consolidated and, as a result of the influence of economic, social and cultural factors, an industrial district emerged within the territorial boundaries of several municipalities, as conceptualized by Becattini (Becattini, 1990).

Meanwhile, in the same period, Vicenza's jewelry production enjoyed a steady growth. The number of firms increased from 40 to 395 and employees from 800 to 5,000 (Thomsen, 2022; Vitantonio, 2022).

The "golden age" of Vicenza's jewelry ended abruptly in the mid-1970s: 1973 and 1979 oil shocks were accompanied by a sharp increase in the prices for precious metals, by global economic stagnation, causing an increase in production costs while the demand was falling. Even after recovering, markets didn't return to previous stable growth patterns. Increased volatility, demand's fluctuations, and high gold prices contributed to the complex and difficult economic context. Many firms were pushed out of the market and the sector shrank significantly. The process, however, had also positive sides. The surviving firms were searching for new production and marketing approaches, they sought to enhance their productivity and production quality, fought for acquiring new markets and clients. They invested in communication, with the aim of exploiting tangible and intangible values, such as local culture and history, linking their products to the world-wide diffused imaginary of Italian and Venetian traditions of high quality, elegance, and sophistication. They created brands to reach visibility at the global level. The district gradually acquired its current features.

The number of active firms was sharply reduced, but the remaining companies showed greater dynamism than in the previous decades. In particular they enhanced products' quality, looked for innovative approaches in design and customization, they exploited tangible and intangible values transmitted by loca tradition, history, and culture, they created brands commercialized at global level. Nowadays, despite the substantial decrease in the number of active firms and employees, Vicenza's jewelry industry maintains its position as a core economic sector at the regional and national level.

Given these premises, the research's objective is to test the hypothesis of the existence of positive correlations between the level of jewelry firms' concentration calculated for the municipal level and the degree of the industry's resilience to external shocks, using as a proxy the differences of the variation in the number of active companies and employees in areas characterized by different degrees of firms' concentration. The research focus-

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es on the period of 2000–2021, characterized by market transformations and external shocks such as the European Monetary Unification (2000), the economic crisis of 2008, the sharp increase in the prices for precious metals in 2008–2013 and 2019–2021, and the pandemic.

Theoretical Framework

Vicenza's jewelry history has been widely discussed as a case study to illustrate the ability of an industrial sector structured within three interrelated Marshallian districts (Vicenza, Trissino and Bassano del Grappa – Fig. 1) to benefit from market opportunities and overcome an economic crisis through processes of adaptation (Beccattini, 1990; Becattini, 2003; Rebellotti, 2007; Economia e Società Regionale, 2017). The mechanization and standardization processes of the 1950s and 1960s was the answer to the booming demand of the post-war years (Gaggio, 2002; Gaggio, 2006; Gaggio, 2007, 128-153). Each of the three districts was built within the hierarchical frameworks around the major companies that controlled strategic knots of the value chain (design, refinishing, marketing, and merchandising). Smaller businesses worked on marginal production or as subcontractors, adding flexibility and complexity to the industry between the 1960s and early 1970s. As part of these trends, both contractors and subcontractors established long-term relations with major international buyers, enlarging the volume of production and opening a window to export markets (De Marchi, 2014; Simoni, 2010).

The oil shock of 1973, rising gold prices (Fig. 2) and the economic transformations of the early 21st century caused a new wave of competitive selection within the district: the number of active firms decreased significantly in the 1970s and in the 2000s. Meanwhile, the crisis forced to accelerate modernization, a process marked by the increasing attention to quality, the use of wider range of precious metals, innovative approaches to design, customization, and brand management (Jiayu, 2018; Leszczynska, 2018).

Figure 1. *Administrative units (municipalities) in the Province of Vicenza*
Source: Official site of the Vicenza's Provincial Administration. Available at: https://www.provincia.vicenza.it/

Figure 2. *Gold prices in 1970–2000*
Source: Trading Economics. Available at: https://tradingeconomics.com/united-states/gold-fixing-price-1030-a-m-london-time-in-london-bullion-market-based-in-u-s-dollars-fed-data.html

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Once again, the territory and the exploitation of its intangible values within "experience-economy" approaches proved to be an effective marketing tool.

Methods and Data

The paper tests the correlation between the index of concentration of jewelry firms calculated at the municipal level and the variation of the number of companies and employees in the same area from 2000 to 2021. This approach allows us to check whether firms working in the contexts characterized by the presence of a high number of companies operating in the same sector (high concentration level) better react to external shocks than those showing lower concentration.

The concentration index is calculated by comparing the proportion of the chosen parameter, in our case the number of firms in a single municipality, with the value of the same parameter at the provincial level (Guarini, 1996; Pinkovetskaya, 2015).

$$Q_{ih} = \frac{A_{ih} / A_{i0}}{A_{0h} / A_{00}}, \quad (1)$$

Q_{ih} is the concentration index of the jewelry industry in municipality i; A_{ih} is the number of active firms operating in the jewelry sector in municipality i; $A_{i0} = \Sigma_h A_{ih}$ is the total number of active firms operating in municipality i; $A_{0h} = \Sigma_i A_{ih}$ is the total number of companies operating in the jewelry sector in all the municipalities in the Province of Vicenza; $A_{0h} = \Sigma_i A_{ih}$, is the total number of firms operating in all the municipalities in the Province of Vicenza.

If a municipality presents Q_{ih} values higher than one, the share of companies operating in the jewelry sector in that territory is higher than the provincial average indicating economic specialization. Q_{ih} values below the unit reflect the opposite situation. Given the development and relative industrial diversification of the Province of Vicenza, high Q_{ih} can be reasonably associated with cluster-like conditions[1].

The data have been taken from the Register of Companies provided by InfoCamere (Italian Chambers of Commerce Information Company. The Register identifies firms operating in the manufacture of coins and medals, jewelry, jewelry and related articles, and in processing of precious stones. To calculate the indexes, we considered only the companies with both a shop and registered office within the same municipality.

The period of time chosen for the analysis encompasses a number of important events for the Italian economy as the European Monetary unification; the economic crisis of 2008–2013; and the first pandemic shocks of February 2020. It was also marked by a long-term rise of gold prices. It appears therefore particularly significant to test the resulting correlation between industrial concentration and resilience to external negative shocks.

Results and Discussion

At the moment Vicenza's jewelry industrial district is undergoing far-reaching transformations. In the province, the economic downturn caused a 59% decrease in the number of employees and 30% decrease in the number of companies in 2000–2021[2]. The trend is all the more serious because it follows the 2008–2010 crisis, which had already brought to an abrupt end the 2000–2005 expansion (+1.54% of employees and +32.47%)[3].

As a consequence, since 2005–2010, the sector has shown an overall negative trend, which continued in the subsequent years[4]. Small and medium-sized firms suffered more than larger ones (–2,5 *versus* –1.9 as a five-year average), which seems to confirm the significance of the firm's size for its ability to respond to markets' uncertainty[5]. The number of active firms (–9.87%) and employees (–10.04%), as well as the average number of employees per firm declined in the two decades, falling from 18.96 in 2000 to 9.20 in 2021.

Within this generally negative picture, there were, however, some positive aspects, for example,

[1] Data refers to the ATECO 2002 codes of activity 36,21,0; 36,22,1-36,22,2; 33,50,0p-36,61,0 for 2000–2008, and ATECO 2007 C32.1 (32,11,0; 32,12,1; 32,11,2; 31,13,0) for 2009-2021 identifying firms engaged in manufacturing of coins and medals, jewelry, jewelry and related articles, and in the processing of precious stones. To calculate these indexes, we considered only the companies with both a shop and a registered office within the same municipality.

[2] Confartigianato Vicenza (2020). Comparto orafo nella provincia di Vicenza: imprese, artigianato e alcuni dati di contesto economico, Elaborazione Flash. Retrieved from https://www.confartigianatovicenza.it/wp-content/uploads/2022/02/EF-Comparto-Orafo-v01-20210115.pdf.

[3] Confartigianato Vicenza (2020). Comparto orafo nella provincia di Vicenza: imprese, artigianato e alcuni dati di contesto economico, Elaborazione Flash. Retrieved from https://www.confartigianatovicenza.it/wp-content/uploads/2022/02/EF-Comparto-Orafo-v01-20210115.pdf.

[4] Camera di Commercio di Vicenza (2021). Tabelle Statistiche. Dati Settore Orafo. Retrieved from https://www.vi.camcom.it/it/servizi/statistica-e-studi/tabelle-statistiche-dati-settoriali.html.

[5] Author's elaborations on data from UnionCamere – Infocamere 2021.

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the positive results in production value, turnover and exports, which confirms the importance of investment in technology to increase companies' productivity as well as the capacity of the sector to retain its competitiveness in the global market[6].

Within this broad framework, we analyzed the above-mentioned trends in the territories with different values of firms' concentration. We have calculated concentration index Q_{ih} on the municipal level, and subsequently aggregated municipalities into homogeneous classes (Tables 1–5). By this way we formed four sets of municipalities. Groups A and B, with $Q_{ih} > 3$ and $2 \leq Q_{ih} \leq 2.99$ respectively, included municipalities with very high and high concentration indexes. Group C encompassed municipalities with average quotient ($1 \leq Q_{ih} \leq 1.99$). Finally, group D included municipalities with low indexes ($0.50 \leq Q_{ih} \leq 0.99$). Municipalities with Q_{ih} lower than 0.50 were not considered. The calculation of the concentration indexes covered five-year periods (2000, 2005, 2010, 2015 and 2021). The tables below present the municipalities included in each class, the relative Q_{ih} value, and, except for the year 2021, the variations in Q_{ih} determining a changes of

[6] Confartigianato Vicenza (2019). Comparto orafo della provincia di Vicenza: imprese, artigianato e alcuni dati di contesto economico, Elaborazione Flash, p. 3. Retrieved from https://www.confartigianatovicenza.it/wp-content/uploads/2020/01/EF_comparto-orafo_v01_20200113.pdf.

Table 1

Groups' Composition and Concentration Index – 2000

A (>3)	B (2 -2.99)	C (1-1.99)		D (0.5-0.99)		
TRISSINO/4.93	CAMISANO VICENTINO/2.63	MUSSOLENTE/1.89	DUEVILLE/1.40	ALTAVILLA VIC./0.98 (↓C)	VALDASTICO/0.79	MONTEGALDA/0.56 (X)
GRUMOLO DELLE ABBADESSE/4.55 (↓C)	CALDOGNO/2.53	QUINTO VICENTINO/1.89 (X)	CASSOLA/1.35	CALVENE/0.95 (↓C)	GRISIGNANO DI ZOCCO/0.75	GRANCONA/0.55 (X)
MONTICELLO CONTE/3.98 OTTO	ARCUGNANO/2.40	LONGARE/1.77 (X)	CAMPOLONGO SUL BRENTA/1.21	POVE DEL GRAPPA/0.89	SOVIZZO/0.71	ROSA'/0.54 (X)
VICENZA/3.84	BOLZANO VICENTINO/2.25	ROMANO D'EZZELINO/1.76	BRESSANVIDO/1.15	SOLAGNA/0.86 (↓B)	BARBARANO/0.66 (X) VIC.	TEZZE SUL BRENTA/0.52 (X)
TORRI DI QUARTESOLO/3.66	ZOVENCEDO/2.02 (X)	CREAZZO/1.58	BASSANO DEL GRAPPA/1.09	MONTEVIALE/0.86 (X)	BROGLIANO/0.66 (X)	VILLAVERLA/0.51
COSTABISSARA/3.06 (↓B)		NANTO/1.55	FOZA/1.07 (X)	GAMBUGLIANO/0.86 ↓C)	POJANA MAGGIORE/0.61	LUGO DI VICENZA/0.50 (X)
		SANDRIGO/1.45	SAN NAZARIO/1.01 (X)	ASIAGO/0.85 (X)	ZUGLIANO/0.58	

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 2

Groups' Composition and Concentration Index – 2005

A (>3)	B (2-2.99)	C (1-1.99)		D (0.5-0.99)	
TRISSINO/4.80	CAMISANO VIC,/2.72	MUSSOLENTE/1.94 (↑C)	CASSOLA/1.27	ZUGLIANO/0.77	VALDASTICO/0.71 (X)
MONTICELLO C.O/4.25	ARCUGNANO/2.59	GRUMOLO D. A./1.62 (↑A)	BRESSANVIDO/1.24	POVE DEL GRAPPA/0.76 (X)	GRISIGNANO DI ZOCCO/0.70
VICENZA/4.07	CALDOGNO/2.49	CREAZZO/1.38	ALTAVILLA VICENTINA/1.18 (↑D) (↓D)	CASTEGNERO/0.75	BARBARANO VI./0.60 (X)
TORRI DI QUARTESOLO/3.94	SOLAGNA/2.35 (↑D)	ROMANO D'EZZELINO/ 1.38	SANDRIGO/1.09	BROGLIANO/0.73 (X)	POJANA MAG./0.53 (X)
	VI035 – COSTABISSARA/2.20 (↑A)	GAMBUGLIANO/1.37 (↑C) (X)	CALVENE/1.09	SOVIZZO/0.73	
	BOLZANO VI,/2.07	BASSANO D. G./1.30	CAMPOLONGO S. B./1.09 (X)		
		NANTO/ 1.29	DUEVILLE/1.06 (↓D)		

Source: The author's calculations are based on the Unioncamere-Infocamere data

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municipality's group in the following period. Municipalities which have not shown any change during the given period are highlighted in gray; those that moved to lower classes, in light gray; and those that rose to higher classes, in dark gray. Capital letters in brackets indicate the class reached at the end of any given period.

The tables show that the location of jewelry firms did not change significantly. Trissino, Bassano del Grappa, Vicenza and the surrounding municipalities maintain their status of relevant jewelry districts, which confirms the importance of history and of strongly embedded traditions (Fig. 1).

Table 3

Groups' Composition and Concentration Index – 2010

A (>3)	B (2-2.99)	C (1-1.99)		D (0.5-0.99)	
TRISSINO/4.97	CALDOGNO/2.92	NANTO/1.87	CASSOLA/1.32	DUEVILLE/0.99 (↓C)	LONGARE/0.83 (↓C)
TORRI D.Q./4.25	CAMISANO VIC./2.73	MUSSOLENTE/1.67 (X)	GRUMOLO d. A. (X)	QUINTO VIC./0.97 (↓C)	GRISIGNANO D. Z,/0.67
VICENZA/4.18	SOLAGNA/2.63	ROMANO D'EZZELINO/1.67	MONTEVIALE/	SOVIZZO/0.97	ALTAVILLA VIC,/0.62
MONTICELLO C.O./3.87	COSTA-BISSARA/2.58 (↓C)	CALVENE/1.50 (X)	BRESSANVIDO/	SAN NAZARIO/0.95 (X)	VALDAGNO/0.60
	ARCUGNANO/2.32	BASSANO D. G./1.39	SANDRIGO/	LUGO DI VIC,/0.91 (↓C)	VILLAVERLA/0.56 (X)
	BOLZANO VI./2.14 (↓C)	CREAZZO/1.33		CASTEGNERO/0.88 (X)	ZUGLIANO/0.55 (X)

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 4

Groups' Composition and Concentration Index – 2015

A (>3)	B (2-2.99)	C (1-1.99)		D (0.5-0.99)	
TRISSINO/5.42	SOLAGNA/2.99 (X)	BOLZANO VIC./1.82	NANTO/1.36	GRANCONA/0.88 (X)	CARRE'/0.57 (X)
VICENZA/4.24	CALDOGNO/2.76	ROMANO D'EZZELINO/1.78 (↓B)	BRESSANVIDO/1.35 (↓D)	GRISIGNANO D. (c) Z./0.82	ZUGLIANO/0.55
TORRI D.Q./4.08	CAMISANO VIC,/2.76	CASSOLA/1.68	MONTEVIALE/1.32 (X)	SOVIZZO/0.79 (X)	VALDAGNO/0.53 (X)
MONTICELLO C. O./4.04	ARCUGNANO/2.21	COSTABISSARA/1.59	CREAZZO/1.22	ALTAVILLA (↓C) VIC./0.63	POJANA MAGG./0.50 (X)
ZOVENCEDO/3.98		DUEVILLE1.43	LUGO DI VIC./1.16 (X)	PIOVENE ROCC./0.59 (X)	VELO D'A./0.50
		LONGARE/1.40	GAMBUGLIANO/1.13 (X)		
		BASSANO D.G./1.40	QUINTO VIC./1.07		
			SANDRIGO/1.04		

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 5

Groups' Composition and Concentration Index- 2021

A (>3)	B (2-2.99)	C (1-1.99)		D (0.5-0.99)	
TRISSINO/5.41	CAMISANO VIC./2,96	MUSSOLENTE/1.74	BASSANO D.G./1.53	BRESSANVIDO/0.97	LUGO DI V./0.91
TORRI d. Q./4.50	GAMBUGLIANO/2.50	CASSOLA/1.63	NANTO/1.50	VAL LIONA/0.97	VELO D'A./0.58
ZOVENCEDO/4.38	CALDOGNO/2.40	CREAZZO/1.62	QUINTO VIC/1.40	ZUGLIANO/0.74	GRUMOLO D.A./0.57
VICENZA/4.08	ROMANO d'E./2.37	COSTA-BISSARA/1.61	DUEVILLE/1.24	MONTECCHIO PRECALCINO/0.69	
MONTICELLO C.O./3.47	ARCUGNANO/2.31	SANDRIGO/1.57	ALTAVILLA/1.20 VICENTINA		
	CALVENE/2.19	BOLZANO VIC./1.40	LONGARE/1.14		

Source: The author's calculations are based on the Unioncamere-Infocamere data

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The groups with the index higher than 2 present marginal variations, whereas those belonging to middle or lower ranges are more volatile. The group with Q_{ih} between 1 and 1.99 lost only 4 municipalities in 20 years, and the group with Q_{ih} between 0.5 and 0.90 lost 8. Areas with high concentration indexes are therefore more stable and resilient than others because they have lost less firms.

We also observe that regarding the polarization of jewelry production, there are significant differences between the municipalities. Trissino maintains the highest concentration level throughout the whole period but its companies' activities do not go beyond the boundaries of this municipality. In other words, it does not perform, at least in the twenty-year period covered by our research, any leading role in the sector's development behind the municipality's boundaries and does not lead to the involvement of adjacent areas in its core business.

The situation in Vicenza and, to a lesser extent, in Bassano is quite different. Almost all the municipalities bordering the provincial capital have been attracted into jewelry production and present remarkably high concentration indexes. The same can be said for Bassano del Grappa, where, though at lower levels than in Vicenza, jewelry spreads beyond the borders of single municipalities. Such differentiation appears substantially consistent with the historical formation of the three jewelry poles. Vicenza, as we have seen, boasts an ancient tradition of jewelry production. The industry has expanded progressively into the surrounding areas through imitative, and subcontracting processes. Bassano's production is more recent and does not appear specifically linked to the city and its specific urban context, which might explain why it goes beyond the municipalities' boundaries. Trissino's district emerged in the mid-1950s as a result of the transformation of mechanical shops into jewelry ones mainly at the initiative of former workers of firms operating in Vicenza's jewelry production. The sector's further development was determined by the success of these first-comers, of their subcontracting strategies mainly based on local personal and family networks. These aspects explain why the cluster is still rooted in one municipality and has not moved beyond its borders.

Finally, the stability of municipalities showing high specialization rates within the general context marked by a long-term crisis, mirrored, as we have seen, by the reduction in the number of employees and active firms, suggests that the territory still represents a valuable source of competitive advantage, compensating for adverse market transformations. This conclusion is confirmed by the worse performance of firms belonging to group D (low concentration) in comparison with groups A, B and C (Tables 6–12).

Table 6

Indicators Territorial Groups – Percentage Variation 2000–2005

	Employees	Number of Firms	Average number of employees per firm	Average Concentration Index
Group A (I.C. >3.0)	5.96	58.51	–33.15	6.51
Group B (I.C. between and 2.0 e 2.99)	44.81	63.95	–11.68	1.36
Group C (I.C. between and a 1.0 e 1.99)	–3.97	27.03	–24.40	–10.01
Group D (I.C between and 0.5 e 0.99)	–31.41	–54.29	50.03	–4.49

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 7

Indicators Territorial Groups – Percentage Variation 2005–2010

	Employees	**Number of Firms**	**Average number of employees per firm**	**Average Concentration Index**
Group A (I.C. >3.0)	–42.19	–33.82	–12.65	1.36
Group B (I.C. between and 2.0 e 2.99)	–44.38	–28.37	–22.35	6.46
Group C (I.C. between and 1.0 e 1.99)	–45.95	–41.70	–7.28	8.72
Group D (I.C. between and 0.5 e 0.99)	36.39	71.88	–20.65	13.51

Source: The author's calculations are based on the Unioncamere-Infocamere data

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Table 8

Indicators Territorial Groups – Percentage Variation 2010–2015

	Employees	Number of Firms	Average number of employees per firm	Average Concentration Index
Group A (I.C. >3.0)	–27.02	–17.69	–11.33	0.74
Group B (I.C. between and 2.0 e 2.99)	–36.49	–40.59	6.90	3.99
Group C (I.C. between and 1.0 e 1.99)	–17.99	5.11	–21.98	–1.79
Group D (I.C. between and 0.5 e 0.99)	–74.63	–50.91	–48.31	–19.65

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 9

Indicators Territorial Groups – Percentage Variation 2015–2021

	Employees	Number of Firms	Average number of employees per firm	Average Concentration Index
Group A (I.C. >3.0)	–10.01	–12.84	3.25	0.36
Group B (I.C. between and 2.0 e 2.99)	–19.44	–6.67	–13.68	–7.52
Group C (I.C. between and 1.0 e 1.99)	–71.66	–62.50	–24.44	6.77
Group D (I.C. between and 0.5 e 0.99)	–89.71	–4.07	–60.29	14.84

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 10

Indicators Territorial Groups – Percentage Variation 2000–2021

	Employees	Number of Firms	Average number of employees per firm	Average Concentration Index
Group A (I.C. >3.0)	–59.77	–24.74	–46.54	9.14
Group B (I.C. between and 2.0 e 2.99)	–58.79	–34.88	–36.71	3.77
Group C (I.C. between and 1.0 e 1.99)	–87.94	–70.81	–58.68	2.59
Group D (I.C. between and 0.5 e 0.99)	–97.56	–90.00	–75.57	0.03

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 11

Homogeneous Territorial Groups – Average Index Concentration 2000–2021

111A (>3)	B (2-2.99)	C (1-1.99)		D (0.5-0.99)	
TRISSINO/5.41	CAMISANO/2.96 VICENTINO	MUSSOLEN-TE/1.74	VI012 – BASSANO D.G./1.53	ZUGLIANO/0.74	LUGO DI V./0.91
TORRI d. Q./4.50	CALDOGNO/2.40	CASSOLA/1.63	NANTO/1.50		
VICENZA/4.08	ARCUGNANO/2.31	CREAZZO/1.62	QUINTO VIC/1.40		
		SANDRIGO/1.57	DUEVILLE/1.24		

Source: The author's calculations are based on the Unioncamere-Infocamere data

Table 12

Indicators Homogeneous Territorial Groups – Percentage Variation 2000–2021

	Employees	Number of Firms	Average number of employees per firm	Average Concentration Index
Group A (I.C. >3.0)	–55.20	–17.19	–50.73	12.35
Group B (I.C. between and 2,0 e 2.99)	–52.45	–27.78	–28.08	5.35
Group C (I.C. between and 1,0 e 1.99)	–54.11	25.71	–58.98	–0.59
Group D (I.C. between and 0,5 e 0.99)	–82.14	–25.00	–65.55	1.09

Source: The author's calculations are based on the Unioncamere-Infocamere data

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To test the correlation between concentration and resilience, we have compared the relative variation of the number of active firms and employees in each territorial class (Tables 6–12). Data clearly show that classes A and B (high and medium-high concentration) perform better in all the selected parameters. Such outcomes are further confirmed if we focus on the municipalities that remained in the same group from 2000 to 2021. The analysis that deals in this case with completely homogeneous classes totally confirms the above-mentioned results (Tables 11-12). our data highlights that concentration levels tend to grow during and after the crisis. Both findings are consistent with the scientific literature stressing the relevance of industrial districts for firms' resilience to external shocks.

Conclusions

The study confirms our initial hypothesis that there is a positive correlation between concentration patterns and economic performance, which was measured by using the number of active firms and employees as proxies. This evidence appears in line with the results of scientific literature on industrial districts, which considers proximity and concentration as elements of strength.

This study represents the first step in broader research that may be continued to verify the resilience to external shocks of sub-sectorial components and explore the differences between single branches of the jewelry industry. The level of investigation could also be disaggregated from that of "homogeneous areas by concentration index" to more analytical levels, e.g. a single municipality or single area within one municipality, or, on the opposite, it could consider spaces with similar production patterns that transcend municipality boundaries. Further research may also include analysis of other sectors, and, if viewed from the comparative perspective, other Italian, European and non-European regions.

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