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Implementing the sharing economy in the context of achieving sustainable economic development in Russia

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ABSTRACT

The sharing economy has gained significant attention both internationally and in Russia. This involves the integration of innovative technologies into national economic systems to promote economic growth and environmental sustainability. The introduction of sharing economy principles has led to sudden, and sometimes unexpected changes in the standards and regulations governing the operations of national economies and their sectors. This has raised concerns among academics and businesses regarding the accuracy and completeness of analyses conducted to assess the full range of benefits and drawbacks associated with these new models of economic behaviour. In this context, this study aims to address the lack of theoretical and empirical understanding of management science by conducting a quantitative analysis of the impact of the sharing economy on Russia's path to sustainable economic growth between 2010 and 2023. Using the quantile autoregressive distributed lag (QARDL) method, a common approach in management research, we consider factors such as population growth, unemployment rates, energy prices, and inflation rates. The findings suggest that the sharing economy has a positive impact on sustainable development across all segments, although its effect on energy efficiency is stronger in higher segments. Based on these findings, we argue that growth of the sharing economy, both within Russia and globally, can promote energy efficiency and sustainable development. Furthermore, the study emphasises the significance of the economic aspect of shared consumption, and recommends that the Russian government adopt legal and administrative measures to promote it. These measures can contribute in achieving sustainable development goals and improving energy efficiency within the Russian economy.

Introduction

In today's developmental landscape, ensuring energy efficiency and sustainable development has become a primary task for governments worldwide. This is particularly important as the increasing utilisation of natural resources to meet economic growth needs is exacerbating the anthropogenic pressure on the environment (Dabbous & Tarhini, 2021). The term 'sustainable development' was first introduced in international practice in 1987. At that time, as well as in contemporary management science, this term was defined as 'the development that meets current needs without compromising the ability of future generations to meet their own needs'. It is important to note that most national and regional standards governing the operations of economic entities, both within Russia and globally, incorporate objectives that address the ecological, social, and economic aspects of sustainable development (Boar et al., 2020). In management science, the foundation of sustainable development is defined by the triple bottom line, which encompasses environmental, economic, and social responsibilities (Elkington, 1994; Longoni & Cagliano, 2018). Furthermore, significant attention is given to the 'Triple P' concept—Planet, Profit, and People—which focuses on analysing the three most significant components of state and corporate social responsibility (Amaladoss & Manohar, 2013). Currently, management science places significant emphasis on the study of both the microeconomic and macroeconomic aspects of sustainable development (Buchholz et al., 2009; Szczuka, 2015). In a macroeconomic context, long-term sustainable development of the national economy is particularly important (Szczuka, 2015). Microeconomics focuses on the viability of sustainable development programmes in individual enterprises. Additionally, a significant complement to microeconomic management research on these issues is the examination of the impact of sustainable development on individuals, non-profit organisations, and governmental institutions (Jelinkova et al., 2021; Salikhov et al., 2019).

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A key theoretical and practical trend in ensuring the economic development of countries today is the reduction in all types of energy used in the production of a given quantity of goods and services. In management science and practice, this trend is known as 'energy efficiency'. The implementation of this trend has several advantages. For example, increasing energy efficiency contributes to the stability of natural ecosystems, reduces carbon dioxide and other greenhouse gas emissions, decreases the use of fossil fuel resources in the national economy, and stimulates competition among producers to lower operational costs (Akram et al., 2020). Thus, energy efficiency has become a fundamental aspect of combating global climate change under contemporary conditions. This goal is pursued through two primary avenues. The first is reducing the amount of energy used, which leads to a corresponding decrease in emissions. This implies that the implementation of energy efficiency involves the development and adoption of energy strategies to combat climate change and global warming. Second, economically justified energy efficiency projects provide companies with certain ecological benefits, primarily manifested in minimising the economic costs associated with achieving climate-related objectives (Akram et al., 2020; Javid & Khan, 2020; Harun et al., 2022). Additionally, energy efficiency has become a crucial component of green development programmes that aim to reduce emissions from production companies, both in Russia and globally (Maheswaranathan & Bhavan, 2022; Shair et al., 2021; Treptow, 2022). It is evident that the pursuit of development goals and the enhancement of energy efficiency are interrelated for Russian companies.

Many authors emphasise that beyond environmental, reputational, and economic benefits, achieving energy efficiency also provides various social advantages to companies (Aliu & Hajdini, 2021; Alsoud et al., 2021; Hernawati et al., 2021). For example, previous research indicates that achieving energy efficiency not only reduces companies' electricity costs, but also stimulates increased production capacity (Hieu et al., 2021; Hussein et al., 2021), enhances energy security (Mattayaphutron & Mahamat, 2021; Nawaz et al., 2021), reduces expenditure on energy carriers, and lowers atmospheric emissions (Nazir et al., 2022; Yilmaz, 2022; Zhironkin et al., 2022). An important focus in the development of management science and practice is to find solutions that can simultaneously achieve sustainable development goals for both national economies and individual companies while also developing and implementing energy efficiency programmes. We believe that a key approach to solving this problem may be the incorporation of elements of the sharing economy into programmes aimed at achieving the development goals. However, some variants of the sharing economy such as those based on the joint use of idle assets are ambiguous and are therefore, considered contentious solutions (Bolobonova et al., 2020; Leung et al., 2019; Rozhkov, 2022a,b). However, in recent years, the sharing economy has increasingly been viewed in management science as an Internet platform that facilitates equal exchange between participants by providing access to products and services (Diligina et al., 2018; Dolgova, 2018; Mi & Coffman, 2019). Furthermore, this perspective is becoming a 'trend in consumer behaviour logic' that is 'evolving more rapidly' both theoretically and practically (Fagerstrøm et al., 2017).

Consequently, we believe that this trend could offer significant social benefits for Russian companies. These benefits include opportunities to economise and/or generate revenue through the sale of emissions quotas, changes in consumer behaviour patterns, reductions in the consumption of various resources by both producers and consumers, and a gradual shift towards sustainable consumption models, thereby laying the foundation for sustainable economic growth. Implementing a sharing economy on a national scale in Russia can yield substantial positive socioeconomic and environmental effects. Under current conditions, the adoption of the sharing economy could serve as a cornerstone for the Russian state and society in shaping a new quality of economic management by enhancing the efficiency of resource utilisation across the country. Several researchers have noted that this approach can lead to improvements in living standards (Alshahrani, 2021; Diep & Hieu, 2021; Hasker, 2021), the creation of new income sources through the development of emerging economic sectors (Ryzhkova et al., 2020; Schor, 2016), and increased accessibility to domestically produced goods and services (Dolgova et al., 2015; Popov et al., 2019; Teslenko et al., 2019). Under the current conditions, the sharing economy model, which encompasses managerial decisions that address economic, social, and environmental responsibilities, is becoming the foundation for sustainable development for both individual companies and the national economic system. Furthermore, the development of the sharing economy, within the context of the transformation of the global economy, is an essential strategy in the development and implementation of technological and organisational management innovations. This, in turn, ensures the sustainability of the production of goods and services, and consequently contributes to the economic security and stability of the state and society. The implementation of a sharing economy qualitatively establishes new mechanisms for forming and maintaining interactions between producers and consumers. Such mechanisms may include models for the shared use of various transportation assets, such as freight trucks and warehouse facilities; systems for exchanging information about delivery/orders, warehouse capacity, contract development, and negotiations across different regions of the world or within a specific country; recommendations for working with intermediaries; and data on joint advertising development and placement or consumer opinions. It is evident that all the aforementioned interaction options within the sharing economy could or already represent sources of multiplicative impact, thereby ensuring the stability of the national economy, whether in Russia or any other country worldwide. Therefore, the development and implementation of the sharing economy has become a significant topic in management science discourse, particularly in relation with economic sustainability and energy efficiency issues (Demailly & Novel, 2014; Geissinger et al., 2019). However, few empirical studies have examined the specific characteristics (Gritsaenko, 2022; Parente et al., 2018; Zenkina, 2021) and consequences of sharing economy models on economic sustainability (Khusainov et al., 2017; Sharko, 2020; Teslenko et al., 2019). These findings underscore the significance of this study. Furthermore, there are management science studies that present well-reasoned arguments, suggesting that the implementation of the sharing economy disrupts the logic of modernising traditional production and consumption models. On one hand, it creates substantial advantages and opportunities for transforming national economies based on mechanisms for energy conservation and the reduction of anthropogenic environmental impacts. On the other hand, it introduces new types of threats and risks, necessitating significant reforms in risk management systems at both organisational and national levels (Pouri & Hilty, 2018).

The analysis presented in this section of the article regarding the theoretical foundations of research on the formation and development of the sharing economy and sustainable development indicates that despite the substantial volume of publications on these topics, the issue of utilising elements of the sharing economy to achieve sustainable development goals requires further elaboration. This is particularly pertinent in the context of exploring theoretical and practical responses to this issue as they are formulated and implemented in Russia. Previously reviewed works by both foreign and Russian scholars have examined the fundamental characteristics of the development and evolution of both the sharing economy and sustainable development goals. Despite the breadth and significance of these studies, they only partially addressed the problems associated with the use of sharing economy elements to achieve sustainable developmental objectives. In our opinion, addressing this gap underscores the relevance of this study. The authors contend that addressing this gap will, on one hand, enable researchers and practitioners to develop an understanding of the logic and directions for analysing the use of sharing economy elements in achieving sustainable development goals as applied in Russia. On the other hand, it will allow them to identify potential applications of the methodologies and findings discussed in this study for their own investigation of this issue. In this context, the objective of the present research is to analyse the characteristics of utilising elements of the sharing economy to achieve goals related to enhancing energy efficiency and sustainable development in Russia for the period 2010–2023 and to assess the impact of these elements on the attainment of these goals. To achieve this objective, we conducted a quantitative assessment and have justified the application of these two models within the scope of this analysis. In the first model, a mechanism was applied to forecast the role of the sharing economy in achieving the sustainable economic development goals. This model was based on impact measures such as population growth, inflation rates, and unemployment levels. The second model identified the relationship between the development of the sharing economy and the reduction in energy intensity among Russian companies. This relationship not only contributes to the improvement of energy efficiency for these companies and the Russian economy, but also accounts for state measures affecting population growth and energy prices.

The analysis of prior research on the nature and practical implementation of the sharing economy and sustainable development supports the relevance of this study's objective, namely, to examine the potential and characteristics of using the elements of the sharing economy to achieve sustainable development goals. To ensure a robust empirical foundation for the hypotheses proposed below regarding 1) the positive impact of using sharing economy elements on the realisation of the objectives of sustainable development in the Russian national economic system, and 2) the negative impact the economy has on the realisation of the objectives of energy efficiency in the Russian economy. Additionally, in the context of this study, we can establish the 'null hypothesis', which posits that the use of elements of the sharing economy does not have a significant (positive or negative) impact on achieving the sustainable development goals of the Russian national economic system or the achievement of energy efficiency objectives in the Russian economy.

This study aims to broaden the scope of research in this area, with the results serving as a foundation for future investigations. The remainder of this manuscript is divided as follows. The first section addresses the fundamental aspects of the study. The second section reviews previous studies on the sharing economy and its relationship with energy efficiency and sustainable development. Section 3 presents the data and methodology. Section 4 presents and discusses the results. Finally, section 5 summarises the conclusions and outlines directions for future research.

Literature review

The concept of 'sharing economy' is not novel in management science. Philosophers and economists have discussed the formation of such a model of economic interaction for the past three-and-a-quarter centuries. Since the Second Industrial Revolution, the sharing economy has been viewed as a model for equitable commercial activity and trade. However, from the mid-19th century, large businesses dominated this model. Consequently, throughout most of the 20th century, European and American states focused on supporting the efficiency of large corporations. This focus was largely driven by rapid technological progress, which increasingly transformed the logic and types of economic exchange, commercial activities, and productivity. This transformation has resulted in significant disparities between countries and regions based on the international division of labour. When evaluating the sharing economy as a socioeconomic phenomenon, it is important to emphasise that its implementation contributes to the growth of systemic coherence and resilience within the economic system, while also increasing efficiency of resource utilisation (Martos-Carrión & Miguel, 2022; Pouri & Hilty, 2021; Toni et al., 2018). Collectively, these factors create conditions conducive to achieving development goals (Hsu, 2023; Peng, 2023; Tu et al., 2023). In contemporary conditions, the increasing significance of digitalisation in socioeconomic relations has created additional opportunities for the rise of the sharing economy and other innovative forms of economic and social interaction (Nozari et al., 2021; Schor, 2016). Digital platforms and technologies have become the backbone of the sharing economy, facilitating connections between individuals and organisations and enabling the utilisation of previously untapped assets. Additionally, they have expanded the scope of the interactions between supply and demand, skills, and knowledge. One advantage of employing a sharing economy to achieve development goals in Russia is the development of a circular economy, which has extended the lifespan of products and materials used in economic circulation and consumption.

The term 'sustainable development' is a popular subject in research and practical applications. This phrase is frequently encountered not only in scientific research, but also in legal documents from national governments and supranational organisations, as well as in frameworks that define the development strategies of major companies and corporations. Despite the substantial volume of research dedicated to exploring the essence of sustainable development, its definitions and interpretations remain a subject of debate within academic and practical communities (Boons et al., 2013; Gong et al., 2018; Mikušová, 2017). Various authors offer diverse interpretations of this term within the context of their studies (Rozhkov, 2022a,b; Strizhakova et al., 2022; Sutopo et al., 2018). In this regard, a widely accepted approach to defining sustainable development is found in the work of researchers, who view it as the integration of goals aimed at achieving a high level of economic development with objectives focused on maintaining ecological and social stability (Barbier, 2019; Parshakov et al., 2021; Zhu et al., 2021).

Based on the aforementioned logic established in management science, it is rational to conclude that sustainable development represents a mechanism for seeking and establishing a compromise in the relationships among the ecological, economic, and social goals of societal efficiency. These goals should form a foundation for the wellbeing of both current and future generations. This conclusion aligns with the assertions made in prior research, which indicates that the economic aspect of sustainable development should not focus solely on meeting the current needs of society. Instead, its implementation involves creating an adequate volume of resources to meet the needs and requirements of future generations, specifically in terms of building natural, material, intellectual, and social capital for society and the state (Ciegis et al., 2009; Cyrek & Fura, 2019). Conversely, the ecological aspect should be aimed at defining and establishing the environmental boundaries within which human activities should be conducted. Moreover, these boundaries must not be violated (Lydeka & Karaliute, 2021; Markova, 2018; Paraschiv et al., 2021). The social aspect involves developing an educational system that equips individuals and society with the necessary knowledge, skills, and competencies to effectively address significant social and governmental tasks, and participate in various developmental processes (Škare et al., 2013; Slatten et al., 2021; Tretyak et al., 2021). According to some researchers, sustainable development plays a crucial role as it becomes a tool for studying and understanding the world and a method that facilitates the identification, analysis, and response of both individual countries and the global community to new global challenges (Darity et al., 2021; George, 1999; Muñoz & Cohen, 2017).

The analysis of prior research on the nature and practical implementation of the sharing economy and sustainable development supports the relevance of this study's objective. As mentioned above, to ensure a robust empirical foundation for the hypotheses proposed below, we established the so-called null hypothesis, which posits that the use of elements of the sharing economy does not have a significant (positive or negative) impact on achieving the sustainable development goals of the Russian national economic system or the achievement of energy efficiency objectives in the Russian economy.

Based on this, we formulate the first hypothesis:

H1. The sharing economy positively influences the sustainable development of Russia's economic system.

As previously noted, a crucial direction in contemporary management science and practice is to address the challenge of simultaneously achieving development goals for both the national economy and individual companies while developing and implementing energy-efficiency programmes. There are numerous potential solutions in management science and practice. However, the authors believe that a key approach may be the integration of the elements of the sharing economy into programmes aimed at achieving sustainable development goals. However, previous studies have not analysed the possibility of forming such a configuration of interrelationships among the elements of the sharing economy and the tasks of ensuring energy efficiency. Certain variants of the sharing economy and their practical implementations, such as a sharing economy based on the joint use of idle assets, have been discussed in detail in the field of management science (Leung et al., 2019; Bolobonova et al., 2020; Rozhkov, 2022a,b). In recent years, management science has increasingly viewed the sharing economy as an 'Internet platform that facilitates equal exchange between participants by providing access to products and services' (Diligina et al., 2018; Dolgova, 2018; Mi & Coffman, 2019). Therefore, we believe that integrating elements of the sharing economy into processes for achieving sustainable development goals could offer significant social benefits for Russian companies and the state. These benefits may include opportunities to save or earn money through emissions trading schemes, changes in consumer behaviour, reductions in resource consumption by both producers and consumers, and a gradual shift towards sustainable consumption models, thereby laying the groundwork for sustainable economic growth. The gap in the existing scientific discourse related to evaluating the impact of incorporating the sharing economy into processes aimed at ensuring the sustainability of Russia's national economic system is addressed further by analysing Hypothesis 1. The relevance of analysing this hypothesis is underscored by the necessity of establishing a relationship between the sharing economy and the achievement of sustainable development objectives within socioeconomic systems. Understanding and evaluating the extent of this mutual influence is a critical theoretical and practical challenge for researchers worldwide.

In management science, there is substantial body of literature on the impact of the sharing economy on sustaining long-term economic growth and ensuring environmental safety (Zmysłony, Leśczyński, Walińgora, & Alejziak, 2020). The sharing economy enhances the environment through the joint use and consumption of existing assets and resources, fostering a sense of community, creating new connections, generating income from idle assets, reducing costs, and providing access to expensive goods (Kleshcheva, 2017). Furthermore, achieving energy efficiency goals boosts the productivity and competitiveness of both individual companies and the national economy (Rajbhandari & Zhang, 2018; Williams & Horodnic, 2017). However, the relationship between implementation of a sharing economy and energy efficiency remains unexplored. Only in the past 6–8 years have specific publications begun to address this issue, which merits further examination in the present study.

The sharing economy addresses the interests of key aspects of sustainable development: ecology, social sphere, and economy. This allows us to assert that organisations operating within this framework achieve three types of effects:

- Social effect: Meeting the needs of the population
- Economic effect: Profit generation

Environmental effects: Changes in consumer habits and reduction in the use of natural resources.

We are experiencing rapid changes in the economy and society, driven by cultural shifts and new technologies. This has created a global transition, characterised by a shift to a fundamentally new world economy that integrates sustainable development with nature, is inclusive, and is grounded in humanitarian disciplines and knowledge (Afanasev, 2022; Kostin et al., 2021). In the sharing economy, individuals are viewed not only as labour and production factors, but also as one of the primary goals of development. Abubakari (2021), Belk (2014), and Muñoz and Cohen (2017) conclude that the sharing economy contributes to energy savings, reduces the amount of waste produced by humanity, and decreases both the carbon footprint and greenhouse gas emissions. Fitrianto and Iskandar (2019) analysed the impact of rising energy prices and GDP per capita on energy intensity in ASEAN countries. Their analysis revealed that both variables negatively affected energy intensity. Mahmood and Ahmad (2018) observe a comparable trend in European economies. Ala-Mantila (2016) examined the relationship between household size, urban structure, lifestyle, and greenhouse gas emissions. Several authors have noted that the development of a sharing economy can reduce individual gas emissions by achieving a balance between significantly lower levels of consumption within household units and certain forms of sharing between households (Surya et al., 2020; Tretyak et al., 2021). Researchers have focused on the impacts of achieving sustainability goals in information and communication technologies on energy consumption and environmental conditions. For example, Coroama and Hilty (2014) note that integrating information and communication technologies into business processes transforms energy and resource consumption across various levels of the supply chain. Bashroush et al. (2016) argued that the rising demand for applications in information and communication technologies drives increased energy consumption, despite the implementation of energy efficiency programmes. Building on this, Das (2019) contended that this trend is a consequence of the sharing economy as its associated software applications require substantial amounts of equipment and data centres, which consume significant natural resources and energy. Ganapati and Reddick (2018) hypothesised that in the long term, the sharing economy may lead to energy savings owing to the development of sustainable and resource-efficient strategies by companies that focus on providing services rather than producing and selling goods. This raises the question of whether the sharing economy has a positive or a negative impact on energy efficiency.

Based on previous research's findings on the sharing economy and its impact on energy efficiency, we formulate the following hypothesis:

H2. The sharing economy negatively affects energy efficiency in the Russian economy.

We provide a detailed description of the current characteristics of energy efficiency and implementation of the sharing economy in Russia. This analysis serves as the starting point for determining the focus of this study. The energy intensity of Russia's economy is three times higher than that of Denmark, two and a half times higher than that of Germany, and almost twice as high as that of Norway, Sweden, and Finland. Only Iceland has a higher energy intensity than Russia. Energy intensity has declined over the past decade in all seven countries. This indicates significant untapped potential for improving energy efficiency in Russia. However, greenhouse gas (GHG) emissions from the Russian energy sector are problematic. The carbon intensity of Russian energy, measured as $CO2$ emissions per unit of energy produced, is three times higher than that of Norway, Sweden, and Iceland; one and a half times higher than that of Finland; and comparable to that of Denmark and Germany. Carbon intensity has been decreasing over the past 50 years in all seven countries examined. The low carbon intensities in Norway and Iceland can be attributed to the high share of renewable energy sources in their energy mixes. Despite the negligible share of renewable energy in Russia's energy sector, its carbon intensity is comparable to that of Denmark and Germany because of its high proportion of natural gas. Energy efficiency plays a crucial role in the transition to a zero-emission economy. If this transition is to be achieved solely by shifting energy production to renewable sources without implementing additional measures to enhance energy efficiency, Russia will require dozens of times more generating capacity, leading to practically insurmountable challenges related to the spatial distribution of new power plants, as well as additional greenhouse gas emissions associated with their construction and commissioning. The following calculations illustrate this assertion regarding Russia.

Currently, Russia produces and consumes approximately 1000 TWh of electricity annually (1064 TWh in 2022). Of this, hydropower plants generated approximately 20% in 2022, whereas other renewable energy sources contributed approximately 1%. If fossil fuels are completely phased out, the entire volume must be generated solely from renewable energy sources. If it is not feasible to supply heating through geothermal energy, solar thermal collectors, low-temperature heat, or biomass, the heating demand will also need to be met with electricity, which amounts to over 2000 TWh annually. In addition, more than 500 TWh is required per year to decarbonise the transportation sector. Thus, the complete decarbonisation of Russia could necessitate over 3000 TWh of electricity from renewable sources, which is three times the current electricity output of all the Russian power plants. Furthermore, in Russia, solar power plants have a capacity utilisation factor—the ratio of the actual electricity generated to the amount that would have been generated if the plant operated at full capacity—of approximately 15 %. This metric is slightly higher for wind power plants, but remains relatively modest. This implies that to generate 3000 TWh annually from wind and solar energy, a total installed capacity of over 2 TW is required. As of 1 January 2022, the installed capacity of power plants in Russia's unified energy system is 0.25 TW. Therefore, without implementing energy-efficiency measures, the required installed generation capacity should be at least eight times greater than the current capacity. The measures planned under the Russian Federation's state programme titled 'Energy Conservation and Energy Efficiency Improvement for the Period Up to 2020′ were projected to achieve primary energy savings of 1124 million tons of fuel equivalent, natural gas savings of 330 billion cubic meters, electricity savings of 630 billion kWh, thermal energy savings of 1550 million Gcal, and oil product savings of 17 million tons by 2020. The anticipated annual savings in electricity alone (63 billion kWh) would exceed the total planned output of Russia's largest nuclear power plants (either the Leningrad NPP 1 or the Kursk NPP, each generating 28 billion kWh per year) and the largest thermal power plant, Surgut GRES (up to 39 billion kWh per year). After 2014, the state programme was suspended and its targets for 2020 were not met. Since then, it has been replaced by other programmes with updated objectives. However, the evaluations underpinning the original programme demonstrated that energy efficiency represents Russia's most significant, cleanest, and cost-effective energy source.

It is important to note that the Russian sharing economy, similar to its global counterpart, has experienced substantial growth. Russia's market share reached 770 billion rubles in 2019. The following segments were developed:

- The C2C Sales Segment: Leading in development, this segment reached 566 billion rubles. It includes platforms such as Avito, Yula, VKontakte, and Instagram and rental services such as Rentmania (Zenkina, 2021).

The P2P Services Segment: This segment, amounting to 140 billion rubles, includes services such as Profi.ru, YouDo, and Workle, along with a notable trend towards the 'gig economy' or economy of side jobs (Gritsaenko, 2022).

- Car Sharing: Ranking third with 20.5 billion rubles, this segment is represented by services such as Uber Yandex, which surpassed carpooling (the practice of sharing rides within a single trip) with 17.8 billion rubles, represented by platforms like Blablacar and Delimobil (Bolobonova et al., 2020).

Short-Term Housing Rentals: Holding the fourth position with 15.6 billion rubles, this segment features services such as Airbnb, Posutochno.ru, and Booking.com. Notably, Airbnb accommodates 22% more tourists compared to the international hotel chain Hilton without the costs associated with acquiring and maintaining property (Teslenko et al., 2019). Social service platforms such as SilverNest and GoGoGrandparent are also gaining traction, primarily in Western countries, while in Russia, users predominantly rely on the Profi.ru platform for similar services, including nannies, governesses, and caregivers. Additionally, food sharing, that is, redistributing food that is nearing its expiration date, has gained momentum. This movement addresses crucial economic, social, and environmental functions given that approximately 30% of all food sold is wasted. During the COVID-19 pandemic, there was a significant increase in the demand for food-sharing services and food banks, although the turnover of these services only increased by 20%. Government support measures have been introduced, including amendments to the Russian Tax Code in 2020 that allow companies to include donated food in their reports as non-operating expenses and provide VAT relief for food-sharing donors (Rozhkov, 2022a,b). The B2B segment is also undergoing a transformation, with an increasing number of companies across various industries (construction, agriculture, energy, logistics, and healthcare) adopting sharing services or creating their own services. This is particularly evident in the field of supply chain management. Services in this sector are becoming increasingly diverse, ranging from platforms for sharing raw materials and supplies to corporate carpooling, seasonal equipment rental, and shared use of cargo transportation. In addition, there is a growing trend of renting reusable containers, which can reduce packaging waste by up to 80%. Sharing services also extend to other sectors of small- and medium-sized businesses for which cost optimisation is critical, such as accounting and IT services (Fedorova, 2022). In the future, a green sharing economy model could encompass the entire lifecycle of businesses and ecological parks, from raw material production to the final product, by selecting responsible suppliers. The sharing services market is rapidly expanding. In 2018 and 2019, the market grew by 30% and 50%, respectively. By 2023, the transaction volume on major sharing economy platforms in Russia reached approximately 1.07 trillion rubles. The social profile of users is evolving; while sharing services were previously popular among the youth, they are now increasingly used by individuals over 40 years of age from various social strata. Additionally, the demand is growing in smaller cities and remote regions of Russia. The popularisation of sharing services is further supported by their integration into the ecosystems of major corporations such as Sberbank and Yandex (Ishtiryakova et al., 2024).

A review of previous research highlights the significant role of the sharing economy in achieving energy-efficiency goals and sustainable development within national economic systems. However, quantitative assessments of this relationship are underexplored in the field of management science. Another significant aspect of this study is that similar analyses on the Russian economy are rare. In this context, this research has several notable achievements. First, it contributes to the body of work dedicated to quantitatively assessing the relationship between the implementation of a sharing economy and achievement of energy efficiency and sustainability goals in the Russian economy. Equally significant is the use of social impact indicators from the Yandex projects in Russia, derived from online reports and surveys, as criteria for evaluating the level of development of the sharing economy. Third, this research is innovative in studying the Russian economic system because it applies the Quantile Autoregressive Distributed Lag (QARDL) model, which evaluates the quantitative relationship across various quantiles to provide a comprehensive view of the interaction. This study contributes substantially to management science by exploring the practical significance of expanding the scope of the sharing economy to enhance energy efficiency and sustainable economic development. The results of this analysis could be valuable not only to researchers, but also to government agencies and decision-makers.

Our study contributes to many aspects of the field. To the best of our knowledge, reviewing the abovementioned extant literature, we observed that there were no papers addressing possible nonlinearities. Thus, we aimed to fill the gap in the literature using the QARDL model and Russian data spanning the period 2010–2023. We hypothesised that if we tested the expected signs of the unemployment rate (negative), sharing economy (positive), population growth (positive), inflation rate (negative), and energy price (positive) variables based on the results of previous empirical observations and studies in the literature, it would help us understand the determinants of the implementation of a sharing economy and the achievement of energy efficiency and sustainability goals. Therefore, the research question in this study is to investigate the possible effects of unemployment rate, sharing economy, population growth, inflation rate, and energy prices on the implementation of a sharing economy and the achievement of energy efficiency and sustainability goals in Russia over the past 13 years, using a QARDL model. These results are in line with the expectations of the study and previous literature. The findings revealed that the error correction term was significantly negative for all autoregressive distributed lag (ARDL) models, but positive for the upper quantiles of the QARDL models.

Data and methodology

To assess the impact of the sharing economy on achieving sustainable development goals and improving energy efficiency within the Russian economic system, we proposed two approaches. The first approach involves evaluating the relationship between the achievement of the development goals and the implementation of a sharing economy. This is based on analysing factors, such as population growth, unemployment rates, and inflation. The second approach focuses on evaluating the relationship between the realisation of energy-efficiency goals and implementing a sharing economy within the system. This study examined the dynamics of energy prices and population growth. The use of these approaches is driven by the need to test the two previously stated hypotheses and obtain comparable and comprehensive results. Based on the work of international researchers such as, Dritsakis and Stamatiou (2016); Mohseni and Joozaryan (2016), Sahnoun and Abdennadher (2019), and Adaramola and Dada (2020) as well as Russian researchers Tagarov (2019), Skavitin (2021), and Popova and Khuseynova (2017), the authors propose the following mathematical model as the analytical basis for the first approach of this study:

$$\theta = f(\text{È};\text{Ů};\text{ç};\pi_t) \tag{1}$$

where Ө represents Gross Domestic Product per capita, Ȅ represents the sharing economy, Ů denotes the unemployment rate, ç indicates population growth, and $\pi_{\text{ç}}$ stands for inflation rate.

For the second approach, drawing on the works of international researchers such as Adom (2015), Mahmood and Ahmad (2018), Dabbous and Tarchini (2021), and Russian researchers Khusyainov and Urusova (2017), Dolgova and Dryazgina (2015), and Vershitskiy and Vershitskaya (2023), the authors propose the following mathematical model as the foundation for the analytical mechanism:

$$\text{Ę} = f(\text{ʾE};\ \text{ç};\ \text{Ə}) \tag{2}$$

where Ę represents energy efficiency, È stands for the sharing economy, ç denotes population growth, and Ə signifies energy prices.

Methodologically, the QARDL model is superior to the linear models for at least three reasons. First, the model allows for locational asymmetry in that the parameters may depend on the location of the dependent variable, energy consumption, within its conditional distribution. Second, the QARDL model simultaneously addresses the long-term relationship between the impact of the sharing economy on achieving development goals and improving energy efficiency within the Russian economic system. Third, contrary to this study, certain studies find evidence of a lack of cointegration between these time series using traditional econometric techniques, such as the Johansen cointegration test and the linear ARDL model. This negative outcome could be explained by the existence of quantile-varying cointegration coefficients in the short term, although the variables continue to move together in the long term (Xiao, 2009). Additionally, the QARDL model allows the co-integration coefficient to vary over the innovation quantiles caused by shocks. Moreover, it is superior to other nonlinear models such as the Nonlinear Autoregressive Distributed Lag (NARDL) model (Shin et al., 2011), in which nonlinearity is exogenously defined because the threshold is set to zero instead of being determined by a data-driven process. For these reasons, QARDL is a suitable candidate for accurately modelling both the nonlinear and asymmetric linkages between the impact of the sharing economy on achieving sustainable development goals and improving energy efficiency within the Russian economic system.

Table 1
Description of Variables and Their Data Sources

Variable Name	Indicator	Data Source for Calculation
Sustainable Development	GDP per capita (constant for 2010 in USD)	Rosstat, World Development Indicators (WDI) World Bank
Sharing Economy	Data on the development of Yandex Go, Delimobil, and other car-sharing projects in Russia	Publications from major Russian and international media, company reports
Energy Efficiency	Total final energy consumption (% of GDP)	Rosstat, World Development Indicators (WDI) World Bank
Inflation	Consumer Price Index (CPI)	Rosstat
Unemployment	Unemployment rate (% of the labour force)	Rosstat
Population Growth	Natural population growth rate (%)	Rosstat

In this study, the degree of sustainable development of the economic system was evaluated based on the gross domestic product per capita for Russia, using 2010 data in U.S. dollars as a constant. The unemployment rate was measured as the ratio of unemployed individuals to the total labour force (as a percentage). Energy efficiency was calculated as the ratio of the total final energy consumption to the GDP. The inflation rate was assessed based on the Consumer Price Index (CPI). Natural population growth rate (in percentage) was used as an indicator of population growth. Data for these indicators were sourced from the Federal State Statistics Service of Russia (Rosstat) and the World Development Indicators (WDI) of the World Bank. Additionally, the sharing economy was evaluated through the lens of the social significance of the Yandex projects in Russia. Information on Yandex's activities in Russia and its stakeholders was obtained from publications in national and international news outlets. The information base for this aspect of the study included reports from Russian companies such as Yandex Go, Delimobil, and other car-sharing platforms, with competition among them being the subject of publications in business newspapers, magazines, and other media. The industry reports and public documents of these companies also served as part of the database for this study. Descriptions of all the variables are presented in Table 1.

Data collection for the quantitative assessment based on the QARDL model was conducted for the period 2010–2023 using the sources described in Table 1. This process involved recording data at the beginning and end of each year during the study period. To ensure the reliability of the data, three of the six variables—'Sustainable Development', 'Sharing Economy', and 'Energy Efficiency'—from Russian official statistics and company reports were cross-referenced with international sources, including the World Bank data and analytical materials from global economic and commercial information outlets. After data collection for a specified period, the average value of each variable was calculated to represent the study period.

In our study, the QARDL model estimations were conducted by considering possible endogeneity and multicollinearity problems among the variables. According to Chang et al. (2021), due to the absence of a correlation of residuals in the ARDL model, there is no endogeneity. Moreover, Suwandaru et al. (2021) mentioned that the ARDL model corrects the endogeneity problem. As mentioned by Sun et al. (2021b, p. 3), the QARDL model considers the possible endogeneity problem. The limitation of the QARDL model is that it is impossible to estimate coefficients at the quantile-on-quantile level, as mentioned by Sharif et al. (2020).

The following equations can estimate the linear ARDL and QARDL model parameters.[1] We used the Schwarz Information Criterion (SIC) to determine the optimal autoregressive (p) and moving average (q) lags. ARDL models are useful compared to others when the order of integration differs among the variables (see Shrestha & Bhatta, 2018, p. 79). The Augmented Dickey–Fuller (ADF), Perron, and Zivot-Andrews unit root tests' results indicated heterogeneity. The mathematical formulations of the aforementioned unit root tests are presented in equations (i), (ii), and (iii). To conduct this research, the authors modified the Zivot–Andrews and Perron tests, which is evident from Equation (iv). The Augmented Dickey-Fuller (ADF) test is one of the most commonly used methods to determine the presence of a unit root in empirical research. The ADF test extends the basic Dickey-Fuller test by including lagged values of the dependent variable. The first differences in the variable, along with the lagged values up to k lags, were regressed against the first difference in the variable, incorporating both constant and linear deterministic trends. This test is represented by the following equation:

$$\Delta Y_t = \mu + \alpha Y_{t-1} + \beta t + \sum_{j-1}^{k} C_j \Delta Y_{t-j} + \varepsilon_t + \ldots \quad \text{(ia)}$$

where Δ is the first difference of the variable, C represents the order of the lag in the autoregressive process, β is the coefficient associated with the time trend, Y refers to the macroeconomic time series, and ε_t is the error term.

In the ADF test, the optimal lag length is selected using the t-sig approach. The null hypothesis posits that the time series contains a unit root, whereas the alternative hypothesis posits the opposite. However, the ADF test may provide biased conclusions regarding the presence of a unit root when structural breaks exist in the time series. This issue arises when a time series is interrupted by shocks that can have a prolonged effect on the series. This situation worsens when the series remains unchanged. Initially, a shock has only a temporary effect; however, if a structural break occurs, it could have a lasting impact. This can unintentionally lead to failure to reject the unit-root hypothesis. Numerous empirical studies using the ADF test have demonstrated that unexplained breaks in a series can reduce the bias in unit root tests.

The Zivot–Andrews methodology is used along with the ADF test to enhance the robustness of the unit root tests applied in this study. The details of this methodology are described below. Zivot and Andrews (2002) extend Perron's (1989) concept by including an endogenous break to the model and creating a sequential break in the trend. Unlike Perron's (1989) model, Zivot and Andrews' (2002) model does not include the dummy variable D(TB). These models are denoted as Models A, B, and C. Sequential changes in the intercept (ϑDU_t) and slope (γDT_t^*) are allowed in Models A and B, respectively. In Model C, simultaneous changes in both the intercept and slope are permitted.

$$A: \Delta Y_t = \mu + \alpha Y_{t-1} + \beta t + \vartheta DU_t + \sum_{j=1}^{k} c_t \Delta Y_{i-j} + \varepsilon_t + \ldots \quad \text{(iia)}$$

$$B: \Delta Y_t = \mu + \alpha Y_{t-1} + \beta t + \gamma DT_t^* + \sum_{j=1}^{k} c_t \Delta Y_{t-j} + \varepsilon_t + \ldots \quad \text{(iiia)}$$

$$C: \Delta Y_t = \mu + \alpha Y_{t-1} + \beta t + \vartheta DU_t + \gamma DT_t^* + \sum_{j=1}^{k} c_t \Delta Y_{t-j} + \varepsilon_t + \ldots \quad \text{(iva)}$$

These equations test the alternative hypothesis of series stationarity against the null hypothesis of a unit root. According to Zivot and Andrews' (2002) model, each data point is considered a potential breakpoint and regressions are performed sequentially for each potential breakpoint. In contrast to Perron (1989), Zivot and Andrews (2002) provide less compelling evidence against unit roots by employing an endogenous breakpoint.

Building on the works of international researchers Ali et al. (2021), Godil et al. (2021), and Shu, Li, Ma, and Qureshi (2022), this study employs the QARDL methodology. The original MATLAB software QARDL model program codes only allow bivariate estimates; therefore, we modified the code to obtain the results presented in the 'Discussion' section for our multiple regressions. Moreover, short- and long-term standard errors were estimated using the delta method (Jin et al. 2021), which should be modified for alternatives. The primary objective of this method was to investigate the presence or absence of a nonlinear relationship between the sharing economy and other variables within this study. The QARDL approach facilitates assessment of the long-term quantile impact of the variables under examination on the sustainable development of the Russian economy. Following Sun et al. (2021a), we applied the Granger causality test. The results of this test provide insights into the direction of the relationship between the variables. Additionally, the Wald test was employed to evaluate both short- and long-term symmetry simultaneously by analysing the dependency of the parameters at each quantile. The formulae and descriptions of the included parameters are presented below. This toolkit serves as the foundation for the mathematical analysis conducted using the ARDL and QARDL models. To commence the process of utilising the assessment of hypotheses formulated through the application of the ARDL and QARDL models, we employed a software package. This has enabled us to develop a mathematical representation of the research approaches outlined in this sections. These approaches are expressed in terms of functions (1) and (2). The mathematical representations are presented in formulas (i) and (ii). The general form of the linear QARDL model is as follows:

Mathematical Foundation of Analysis for the First Approach:

$$\Theta_t = \alpha + \sum_{i}^{p} \beta_1 \Theta_{t-i} + \sum_{i}^{q} \beta_2 \grave{\mathrm{E}}_{t-i} + \sum_{i}^{r} \beta_3 \varsigma_{t-i} + \sum_{i}^{s} \beta_4 \mathring{U}_{t-i} + \sum_{i}^{u} \beta_5 \pi_{t-i} + \varepsilon_t \quad \text{(i)}$$

and the Mathematical Foundation of Analysis for the Second Approach:

[1] MATLAB Version 2022a (February 2022) was used to estimate parameters. The MATLAB codes for the QARDL model are available at: URL: https://web.yonsei.ac.kr/jinseocho/qardl.htm (accessed on 1 September 2024).

$$Ȩ_{t} = \alpha + \sum_{i}^{p} \beta_1 Ȩ_{t-i} + \sum_{i}^{q} \beta_2 {'E}_{t-i} + \sum_{i}^{r} \beta_3 ς_{t-i} + \sum_{i}^{s} \beta_4 Ə_{t-i} + \varepsilon_t \quad \text{(ii)}$$

The next step was to develop a mathematical model for the application of the Schwarz Information Criterion (SIC) to select lag orders p and q, where τ represents the white noise error. The Schwarz Criterion, also known as the Schwarz Information Criterion (SIC) or Bayesian Information Criterion (BIC), is used for model selection among finite sets of models. It is widely used in econometrics, statistics, and machine learning to select an optimal model that best fits the data without overfitting. The BIC is particularly useful because it introduces a penalty term for the number of parameters in the model, which helps prevent overfitting. As the number of parameters increases, the penalty becomes more severe, thereby discouraging the selection of overly complex models. The model with the lowest BIC value is generally preferred because it provides the best balance between fit and complexity. The variables Θ, È, ç, Ů, π, and ◒ denote sustainable development, the sharing economy, population growth, unemployment rate, inflation rate, and energy prices, respectively. Based on the aforementioned features of the SIC, we transform Equations (i) and (ii) into their quantile forms, as demonstrated below in Equations (iii) and (iv):

$$Q\Theta_t = \alpha(\tau) + \sum_{i}^{p} \beta_1(\tau)\Theta_{t-i} + \sum_{i}^{q} \beta_2(\tau)\grave{E}_{t-i} + \sum_{i}^{r} \beta_3(\tau)ç_{t-i} + \sum_{i}^{s} \beta_4(\tau)\mathring{U}_{t-i} + \sum_{i}^{u} \beta_5(\tau)\pi_{t-i} + \varepsilon_t(\tau) \quad \text{(iii)}$$

$$QȨ_{t} = \alpha(\tau) + \sum_{i}^{p} \beta_1(\tau) Ȩ_{t-i} + \sum_{i}^{q} \beta_2(\tau) {'E}_{t-i} + \sum_{i}^{r} \beta_3(\tau) ς_{t-i} + \sum_{i}^{s} \beta_4(\tau) Ə_{t-i} + \varepsilon_t(\tau) \quad \text{(iv)}$$

where the indicators ε (τ) = $EF_t - Q_{EFt}\left(\frac{\tau}{\varepsilon t-1}\right)$ and 0 <τ < 1 denote the quantiles.

To apply the approaches to data analysis, several pairs of quantiles ranging from 0.04 to 0.97 are examined. The white noise disturbance term in equations (v) and (vi) accounts for potential serial associations:

$$Q_{\Delta\Theta_t} = \alpha(\tau) + \rho\Theta_{t-1} + \varphi_1\grave{E}_{t-i} + \varphi_2 ç_{t-i} + \varphi_3\mathring{U}_{t-i} + \varphi_4\pi_{t-i} + \sum_{i}^{p} \beta_1(\tau)\Theta_{t-i} + \sum_{i}^{q} \beta_2(\tau)\grave{E}_{t-i} + \sum_{i}^{r} \beta_3(\tau)ç_{t-i} + \sum_{i}^{s} \beta_4(\tau)\mathring{U}_{t-i} + \sum_{i}^{u} \beta_5(\tau)\pi_{t-i} + \varepsilon_t(\tau) \quad \text{(v)}$$

$$Q_{\Delta Ȩ_{t}} = \alpha(\tau) + \varphi_1 Ȩ_{t-i} + \varphi_2 {'E}_{t-i} + \varphi_3 ς_{t-i} + \varphi_4 Ə_{t-i} + \sum_{i}^{p} \beta_1(\tau) Ȩ_{t-i} + \sum_{i}^{q} \beta_2(\tau) {'E}_{t-i} + \sum_{i}^{r} \beta_3(\tau) ς_{t-i} + \sum_{i}^{s} \beta_4(\tau) Ə_{t-i} + \varepsilon_t(\tau) \quad \text{(vi)}$$

The next critical step in the development of a rigorous mathematical framework for verifying our hypotheses employing the ARDL and QARDL approaches involves the development of a precise mathematical model for integrating an error-correction component into these frameworks. An Error Correction Model (ECM) is a statistical technique used in economics and econometrics to estimate the speed at which a dependent variable returns to its equilibrium state after changing other variables. ECMs are particularly useful in time-series analysis when non-stationary data, which are data whose statistical properties, such as mean and variance, change over time, need to be analysed. This concept is based on the idea that deviations from long-term equilibrium will be corrected gradually through a series of short-term adjustments. Error Correction Models are vital for several reasons. They distinguish between short-term fluctuations and long-term relationships, providing insights into how variables interact over different time horizons. This is particularly important in policy analysis, where understanding the temporary versus permanent effects of policy changes or external shocks is crucial.

Next, the equations are presented using the ECM, in which equations (vii) and (viii) incorporate the quantile approach of the ARDL model:

$$Q\Theta_t = \alpha(\tau) + \rho(\tau)\Theta_{t-1} - \omega_1(\tau)\grave{E}_{t-i} - \omega_2(\tau)ç_{t-i} - \omega_3(\tau)\mathring{U}_{t-i} - \omega_4(\tau)\pi_{t-i} - \sum_{i=1}^{p-1} \beta_1(\tau)\Delta\Theta_{t-i} + \sum_{i=1}^{q-1} \beta_2(\tau)\Delta\grave{E}_{t-i} + \sum_{i=1}^{r-1} \beta_3(\tau)\Delta ç_{t-i} + \sum_{i=1}^{s-1} \beta_4(\tau)\Delta\mathring{U}_{t-i} + \sum_{i=1}^{u-1} \beta_5(\tau)\Delta\pi_{t-i} + \varepsilon_t(\tau) \quad \text{(vii)}$$

$$Q\Delta Ȩ_{t} = \alpha(\tau) + \rho(\tau) Ȩ_{t-i} - \omega_1(\tau) {'E}_{t-i} - \omega_2(\tau) ς_{t-i} - \omega_3(\tau) Ə_{t-i} + \sum_{i=1}^{p-1} \beta_1(\tau)\Delta Ȩ_{t-i} + \sum_{i=1}^{q-1} \beta_2(\tau)\Delta {'E}_{t-i} + \sum_{i=1}^{r-1} \beta_3(\tau)\Delta ς_{t-i} + \sum_{i=1}^{s-1} \beta_4(\tau)\Delta Ə_{t-i} + \varepsilon_t(\tau) \quad \text{(viii)}$$

Table 2
Description of Calculated Statistical Data

Variable	Mean	Minimum Value	Maximum Value	Standard Deviation	Jarque-Bera Statistic
Sharing Economy	0.345	0.006	1.003	2.078	10.986***
Energy Efficiency	0.29	0.028	0.58	5.994	11.998***
GDP per Capita	4.75	43.99	67.96	0.896	14.997***
Energy Prices	1.299	33.50	43.95	6.790	42.886***
Population Growth	0.19	0.98	3.09	4.598	39.989***
Inflation Rate	2.115	1.03	6.5	1.233	17.975***
Unemployment Rate	1.80	2.63	4.1	4.579	10.899***

Note: *=P > 0.05, **=P = 0.05, and ***=P < 0.05

The overall short-term effect of previous levels of GDP per capita and energy efficiency on their current levels is determined using the delta approach, as specified by the formula $\beta_* = \sum_{i=1}^{p-1} \beta_1$.

In turn, the aggregate short-term impact of current and future values of the sharing economy indicator on current levels of energy efficiency and GDP per capita is calculated as follows $\beta_* = \sum_{i=1}^{q-1} \beta_2$.

The residual aggregate short-term effects of the previous and current values of the control variables were computed using a similar procedure. It is important to note that the adjustment speed parameter in equation (iv) should be negative and statistically significant (Cho et al., 2015).

To substantiate the results obtained from the previously described mathematical calculations, we employed Wald and Granger causality tests. The use of the Wald test in this study was motivated by the need to identify both the long- and short-term asymmetric effects of all independent variables, specifically the adjustment speed parameters, with hypotheses H0 ρ^* (0,03) = ρ^* (0,08)… ρ^* (0,87). This hypothesis also needs to be tested for the long-term parameters for $\beta_{\grave{E}}$, $\beta_{\mathring{U}}$, $\beta_{Ç}$, and β_π and the short-term parameters for $\sigma_{\grave{E}}$, $\sigma_{\mathring{U}}$, $\sigma_{Ç}$, and σ_π.

The Wald test is based on a chi-square distribution and is used to test whether parameters are the same. Rejecting the null hypothesis of this test provides asymmetry between the short- and long-term parameters in each quantile. The Wald test was designed to analyse the equality of each coefficient in different quantiles for long and short runs. Therefore, if the null hypothesis of equality is rejected, we can claim that this variable's effect on the sharing economy is heterogeneous or asymmetric. The Wald statistics for Models 1 and 2 reject the null hypothesis, which indicates asymmetry within the short- and long-run coefficients in different quantiles. Therefore, the estimated coefficients, which distort the linearity condition of some of the previous methods, were not consistent in the sample.

The application of the Granger causality test allows for the analysis of quantile Granger causal relationships between the dependent and independent variables. Note that the test assumes no Granger causality between variables (X_i) and (Y_i) if X_i does not contribute to the forecast of Y_i. The mathematical basis for this assumption is as follows: ($N_{i=1} N_i^y$, $N_i^{x'} \epsilon R^e, s = o + q$, where N_i^x denotes the most recent group of predictors for X_i $N_{ix} = (X_{i-1}, \ldots, X_{i-q})'$ 2 R^q. Regarding H0, the mathematical basis for the absence of Granger causality between X_i and Y_i is

$$H_0^{X-Y} : F_y\left(yN_i^Y, N_i^X\right) = F_y\left(yN_i^Y\right), for\ all\ y\epsilon R \tag{ix}$$

where Y_i is $F_{y.}$ (.| N_i^Y,N_i^X), and the preliminary goal of the distribution is given (N_i^Y, N_i^X). The DT test is applied according to the QAR m (●) classification method for all π ϵ⊂Γ [0,1] based on the null hypothesis of no Granger causality.

In this case,

$$QAR(1) : m^1\left(N_i^Y, \partial(\pi)\right) = \lambda_1(\pi) + \lambda_2(\pi)X_{i-1} + \mu_2\Omega_Y^{-1}(\pi) \tag{x}$$

The coefficients [$\partial(\pi)$= ($\lambda_1(\pi)$ $\lambda_2(\pi)$] and μ_t are estimated using maximum likelihood at equal quantile points, where Ω_Y^{-1}(.) represents the inverse fundamental distribution function. As a result of these transformations, the QAR(1) equation takes the form of equation (xi):

$$Q_\pi^Y\left(Y_i N_i^Y, N_i^X\right) = \lambda_1(\pi) + \lambda_2(\pi)Y_{i-1} + n(\pi)X_{i-1} + \mu_2\Omega_Y^{-1}(\pi) \tag{xi}$$

Discussion

The initial stage in the process of conducting an empirical investigation based on the mathematical formulations outlined in the preceding section entailed the compilation and synthesis of statistical data presented in Table 1, which pertains to the variables under consideration. Table 2 summarises the calculated statistical data, including mean values, standard deviations, ranges, and Jarque–Bera (J-B) test statistics for the variables under investigation. Among these variables, GDP per capita exhibits the highest mean value, whereas energy efficiency exhibits the lowest. Additionally, the standard deviation reveals that energy prices exhibit the greatest variation compared to the other variables, whereas GDP per capita demonstrates the lowest variation. Finally, the Jarque-Bera test results indicate significant values for all variables, which rejects the null hypothesis, H0, of normal distribution at the 1% significance level. This underscores the importance of employing the ARDL method to forecast short- and long-term relationships across quantiles in the current study.

The next stage in the empirical research process involved the application of unit root tests, as outlined in Tables 1 and 2, to the data obtained through the mathematical analysis. It is worth noting that the primary mathematical tools employed for detecting a unit root within the context of this investigation are the Augmented Dickey–Fuller test and the Zivot–Andrews test. Table 3 details the results of the unit root tests conducted for all variables in this study. Two types of tests were employed to examine the presence of a unit root: the Zivot-Andrews (ZA) and ADF tests. In statistical analysis, the ADF test assesses the null hypothesis that a unit root is present in the time-series data sample. The alternative hypothesis varies depending on the specific version of the test used but generally posits stationarity or trend stationarity. The augmented version of the Dickey-Fuller test was applied to larger and

Table 3
Results of Unit Root and Stationarity Tests

Variable	ADF (Level)	ADF (Δ)	ZA (Level)	Break Year ZA (Level)	ZA (Δ)	Break Year ZA (Δ)
Energy Efficiency	-0.105	-2.498***	-2.999	14.09.2017	-2.689***	14.11.2010
Sharing Economy	-0.065	-3.259***	-4.547	08.06.2023	-3.723***	29.04.2015
Population Growth	-0.799	-2.989***	-3.612	04.04.2023	-4.699***	12.10.2010
Energy Prices	-0.412	-3.015***	-2.356	30.01.2023	-4.499***	15.11.2011
Unemployment Rate	-1.378	-4.100***	-3.036	14.07.2023	-3.698***	27.12.2017
Inflation Rate	-0.296	-2.189***	-4.863	25.02.2015	-4.591***	01.09.2023
GDP per Capita	-0.223	-2.999***	-3.012	18.12.2019	-2.456***	23.03.2018

Note: Statistical values for the ADF and ZA tests are listed in the table.
*=P < 0.05, **=P = 0.05, and ***=P > 0.05.

Table 4
Results of Mathematical Analysis Using QARDL Model 1.

Quantile (r)	Constant $\alpha_*(\tau)$	Error Correction Model $\rho_*(\tau)$	Long-Term Parameters Analysis				Short-Term Parameters Analysis				
			$\beta_E(\tau)$	$\beta_Ç(\tau)$	$\beta_Ü(\tau)$	$\beta_\pi(\tau)$	$\varphi_0(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$	$\varepsilon_0(\tau)$
0.05	0.017	-0.323***	0.589***	0.047	-0.423***	-0.421	0.219***	0.214***	0.023	-0.546***	-0.321
	(0.120)	(-2.299)	(4.295)	(1.017)	(-2.035)	(-1.018)	(2.030)	(2.697)	(0.357)	(-2.185)	(-0.021)
0.1	0.024	-0.331***	0.412***	0.014	-0.308**	-0.515	0.028***	0.438***	0.342	-0.429***	-0.052
	(0.035)	(-2.156)	(2.108)	(1.312)	(-2.901)	(-1.012)	(2.299)	(2.412)	(0.275)	(-2.405)	(-0.062)
0.2	0.032	-0.019***	0.542***	0.020	-0.111**	-0.294	0.007***	0.032***	0.068	-0.904***	-0.005
		(-4.123)	(2.512)	(1.213)	(-2.378)	(-0.019)	(2.276)	(2.389)	(0.213)	(-2.378)	(-0.010)
0.3	0.049	-0.189***	0.231**	0.024	-0.107***	-0.810	0.115***	0.346***	0.047	-0.340***	-0.014
	(0.068)	(-2.325)	(2.308)	(1.499)	(-2374)	(-0.212)	(2.597)	(2.734)	(0.068)	(2.679)	(0.041)
0.4	0.002	-0.006***	0.420**	0.043	-0.401***	-0.051	0.531***	0.149**	0.531	-0.263***	0.100
	(0.032)	(-2.125)	(2.312)	(1.304)	(-2.011)	(-1.697)	(2.271)	(2.604)	(0.271)	(-2.474)	(-0.042)
0.5	0.017	-0.026***	0.198**	0.020	-0.302***	-0.478	0.425***	0.312**	0.447	-0.332***	-0.011
	(0.009)	(3.894)	(3.901)	(1.299)	(-2.403)	(1.067)	(2.031)	(2.453)	(0.071)	(-2.520)	(-0.034)
0.6	0.013	-0.372***	0.427**	0.043	-0.303***	-0.302**	0.511***	0.612**	0.653	-0.492**	-0.036
	(0.002)	(-2.295)	(2.701)	(1.320)	(-2.699)	(-2.294)	(2.392)	(2.687)	(0.248)	(-3.010)	(-0.026)
0.7	0.002	-0.197***	0.206**	0.341	-0.291	-0.651**	0.213***	0.330**	0.761	-0.249**	-0.004
	(0.009)	(-2.006)	(2.599)	(0.859)	(-0.103)	(-2.761)	(2.492)	(2.429)	(0.459)	(-2.734)	(1.026)
0.8	0.005	-0.273**	0.222*	0.281	-0.116	-0.541**	0.419***	0.531**	0.752	-0.526**	-0.091
	(0.002)	(-4.117)	(2.401	(0.001)	(-1.057)	(-2.323)	(2.321)	(2.063)	(0.539)	(2.821)	(-0.034)
0.9	0.007	-0.434***	0.414*	0.947	-0.421	-0.721***	0.024***	0.029**	0.543	-0.600***	-0.007
	(0.001)	(-2.018)	(2.224)	(1.012)	(-1.267)	(-2.302)	(2.414)	(2.599)	(0.452)	(-3.049)	(-0.010)
0.95	0.016	-0.199***	0.220*	0.117	-0.156	-0.151**	0.414***	0.101**	0.073	-0.519***	-0.004
	(0.004)	(-2.115)	(2.319)	(-0.011)	(-0.421)	(-2.521)	(2.013)	(2.829)	(0.025)	(-2.321)	(-0.654)

Note: This table presents the quantile estimation results. The t-statistics are provided in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively. Source: Compiled by the authors.

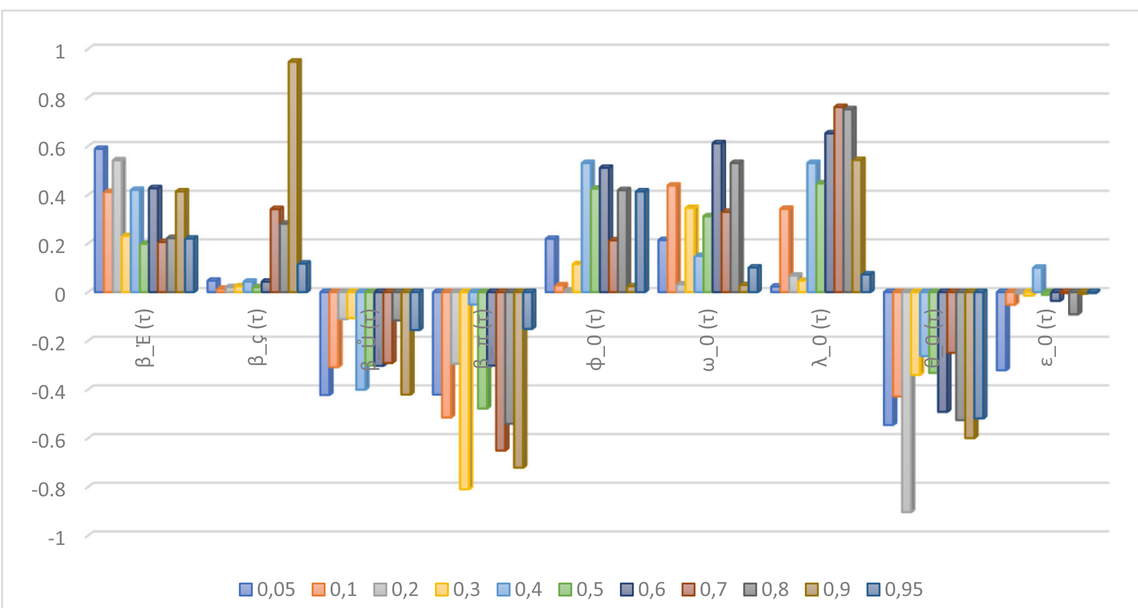

Fig. 1. Graphical view of results of mathematical analysis using QARDL Model 1.
Source: Compiled by the authors.

more complex time-series models.

The ADF test used in this study yielded negative results. The more negative the value, the stronger is the rejection of the null hypothesis of a unit root at a given level of significance. Conversely, the ZA test was employed to examine the presence of a unit root in the case of a single structural break in the time series (i.e. at the level, trend, or both). At the 5% significance level, both tests indicated that the data were nonstationary (see Table 3). This suggests that all the variables exhibit the same order of integration, specifically, I(1).

Based on the information presented in Tables 2 and 3, a sufficient volume of empirical data is generated for the analysis of variables within the framework of the QARDL approach. The following is a summary of the calculated data and the characteristics of the findings obtained through the mathematical analysis using the QARDL method, as described in the Data and Methodology section, expressed in terms of formula (1). Additionally, a mathematical representation of the analysis process using the QARDL technique is provided in formula (i), which was presented in the previous section. The results in Table 4 and Fig. 1 demonstrate that the adjustment speed coefficient r (τ) is significant and negative across all quantiles. The data indicate a trend in which GDP per

Table 5
Results of the Wald Test for Assessing Parameter Constancy in Model 1

Parameter name	Wald test result (p-value)
P	13.321*** [0.000]
$\beta_{\text{‘E}}$	14.841*** [0.000]
$\beta_{\mathring{U}}$	4.265*** [0.000]
β_{ς}	4.084*** [0.000]
β_{π}	5.020*** [0.000]
φ_0	17.812*** [0.000]
ω_0	4.799*** [0.000]
λ_0	1.523*** [0.000]
θ_0	8.563*** [0.000]
ε_0	4.999 [0.000]

Note: P values are indicated in square brackets. ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively. Source: Compiled by the authors.

capita and other variables evaluated in the study, such as the sharing economy, unemployment rate, population growth rate, and inflation rate, tend to revert to a long-term equilibrium. Furthermore, the table depicts that the adjustment speed coefficient was significantly higher in the lower and middle quantiles and lowest in the higher quantiles.

It is important to emphasise that the coefficient reflecting the level of the sharing economy development is positive and significant across all quantiles. This indicates that implementation of the sharing economy could be a crucial factor in ensuring the sustainable development of Russia's economic system. The results demonstrate that the sharing economy has the potential to contribute significantly to accelerating long-term economic growth by increasing Russia's share of the GDP. Consequently, the first hypothesis is confirmed. This conclusion aligns with the perspectives of several scholars including Curtis and Lenner (2019), Jelinkova et al. (2021); Karobliiene and Pilinkiene (2021), Fedorova (2022); Kleshcheva (2017), and Afanasev (2022). Their research suggests that the development and implementation of a sharing economy should enhance the effectiveness of programmes and projects aimed at reducing resource and energy consumption and creating conditions for achieving sustainable development goals. We conclude that the development and implementation of a sharing economy can enhance the long-term resilience of Russia's economic system. This is contingent upon implementing measures within this framework to reduce the overall consumption of resources by households and businesses as well as mechanisms to decrease pollutant emissions. It is also crucial to note that increasing the prominence of the sharing economy within Russia's economic system could significantly boost energy efficiency in enterprises, organisations, and urban infrastructure, as well as improve living standards and quality of life. However, it is important to highlight that despite the current unemployment rate in Russia being 4% according to Rosstat, the coefficient reflecting unemployment in our study illustrates significantly negative values only within the lower to middle quantile range (0.10−0.60). These results suggest a relationship between unemployment dynamics and a rise or decline in the resilience of the economic system. Based on these findings, we conclude that the relationship between unemployment dynamics and an increase or decrease in economic system resilience is influenced by both economic and social issues. These findings are consistent with conclusions drawn by Akinnifesi (1986), Rowley and Feather (1987), Anghel et al. (2017), Sileika and Bekeryte (2013), Khusyainov et al. (2017), Popova et al. (2017), Vershitskiy et al. (2017), Veretennikova (2023), and Kireeva et al. (2021). Our data indicate that the impact of population growth on the resilience of Russia's economic development is minimal across all quantiles (0.10−0.95). Conversely, as anticipated, the inflation rate is a significant negative factor affecting the stability of the economic system and is particularly impactful in the middle and higher quantiles (0.60−0.95). It is important to note that this result aligns with the findings of various international and Russian authors, such as Adaramola and Dada (2020), Hussain et al. (2023), Madurapperuma (2016), Skavitin (2018), Suhodolov and Timofeev (2018), and Dolgova et al. (2015), who note that inflation impedes the achievement of development goals and the stability of economic growth.

The next stage in the empirical research scrutinised the coherence of the results obtained by evaluating Model 1 using the QARDL methodology. To achieve this goal, as mentioned earlier, the Wald test was utilised. The Wald test is based on a chi-square distribution and used to test whether parameters are the same. Rejecting the null hypothesis of this test provides asymmetry between the short- and long-term parameters in each quantile. The Wald test is designed to analyse the equality of each coefficient in different quantiles for long and short runs. Therefore, if the null hypothesis of equality is rejected, we can claim that this variable's effect on the sharing economy is heterogeneous or asymmetric. The Wald test results presented in Table 5 were used to evaluate the consistency of the parameters examined in this study. These results do not support our null hypothesis (H0) regarding the linearity of ECM parameters. Based on the data in Table 5, there is a mathematically significant degree of integration in the coefficients of GDP and sharing economy. This finding suggests a significant and stable relationship between energy efficiency and energy prices, which varies across quantiles. A similar relationship with significant changes in the Wald test coefficients across various quantiles is observed for unemployment,

Table 6
Results of the Quantile Granger Causality Test for Causal Relationships Between Indicators in Model 1

Quantile	$\Delta\theta_t$ ↓ $\Delta \text{‘E}_t$	$\Delta \text{‘E}_t$ ↓ $\Delta\theta_t$	$\Delta\theta_t$ ↓ $\Delta\varsigma_t$	$\Delta\varsigma_t$ ↓ $\Delta\theta_t$	$\Delta\theta_t$ ↓ $\Delta\pi_t$	$\Delta\pi_t$ ↓ $\Delta\theta_t$	$\Delta\theta_t$ ↓ $\Delta\mathring{U}_t$	$\Delta\mathring{U}_t$ ↓ $\Delta\mathring{U}_t$
[0.05−0.95]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.05	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000
0.10	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000
0.20	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
0.30	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000
0.40	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000
0.50	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000
0.60	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000
0.70	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000
0.80	0.000	0.000	0.000	0.000	0.012	0.000	0.000	0.000
0.90	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
0.95	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Compiled by the authors.

Table 7
Results of Mathematical Analysis Using QARDL Model 2.

Quantile (r)	Constant $\alpha_*(\tau)$	Error Correction Model $\rho_*(\tau)$	Long-Term Parameters Analysis			Short-Term Parameters Analysis			
			$\beta_{\text{'E}}(\tau)$	$\beta_{\text{Ə}}(\tau)$	$\beta_{\text{ç}}(\tau)$	$\varphi_0(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$
0.05	0.108 (0.020)	-0.003*** (-5.110)	0.019 (0.465)	-0.247*** (-2.221)	0.611** (1.818)	0.419*** (3.030)	0.314 (2.579)	0.324** (2.219)	0.543 (2.065)
0.1	0.009 (0.018)	-0.878*** (-4.266)	0.431 (1.017)	-0.441*** (-2.318)	0.235** (2.352)	0.038*** (2.049)	0.420 (2.412)	0.340** (2.515)	0.029 (2.423)
0.2	0.017 (0.001)	-0.195*** (-2.032)	0.040 (0.216)	-0.530*** (-2.233)	0.74** (2.413)	0.337*** (2.416)	0.532* (2.409)	0.018* (2.220)	0.624 (2.948)
0.3	0.004 (0.068)	-0.969*** (-2.255)	0.217 (0.076)	-0.724*** (-2.569)	0.025** (2.322)	0.225*** (2.417)	0.426* (2.764)	0.327 (2.214)	0.432 (2.639)
0.4	0.001 (0.036)	-0.796*** (-4.042)	0.018 (0.011)	-0.048*** (-2.922)	0.205** (2.009)	0.527*** (2.921)	0.619** (2.613)	0.434 (2.010)	0.214 (2.621)
0.5	0.067 (0.018)	-0.486*** (-2.000)	0.218 (0.749)	-0.078** (-2.719)	0.228*** (2.037)	0.285*** (2.012)	0.310** (2.963)	0.427 (2.321)	0.302* (2.482)
0.6	0.002 (0.014)	-0.252*** (-3.865)	0.217 (0.020)	-0.621*** (2.070)	0.114 (0.872)	0.412*** (2.115)	0.321** (2.623)	0.426 (2.415)	0.534* (2.628)
0.7	0.022 (0.002)	-0.593*** (-4.876)	0.206 (0.022)	-0.630*** (2.059)	0.110 (0.881)	0.418*** (2.132)	0.340** (2.627)	0.437 (2.420)	0.244** (2.684)
0.8	0.004 (0.001)	-0.173** (-2.749)	0.422** (2.411)	-0.651*** (-2.423)	0.129 (1.242)	0.014*** (2.420)	0.424** (2.960)	0.721 (2.309)	0.320** (2.961)
0.9	0.006 (0.002)	-0.624** (-2.858)	0.4614** (2.217)	-0.077*** (-2.634)	0.121 (1.330)	0.432*** (2.314)	0.329** (2.649)	0.430 (2.417)	0.287*** (2.072)
0.95	0.020 (0.003)	-0.575*** (-2.065)	0.432*** (2.324)	-0.067*** (-0.011)	0.145 (0.921)	0.424*** (2.526)	0.514** (2.822)	0.715 (2.020)	0.329*** (4.091)

Note: This table presents the quantile estimation results. The t-statistics are presented in parentheses. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Source: Compiled by the authors.

Fig. 2. Graphical view of results of mathematical analysis using QARDL Model 2.
Source: Compiled by the authors.

population growth, and inflation rates.

The second stage in the validation of the findings from the mathematical analysis of Model 1, conducted using the QARDL method, involved the application of the Granger causality test. In the economic literature, whether a variable is a precursor to another variable has been examined within the framework of causality analysis developed by

Table 8
Results of the Wald Test for Assessing Parameter Constancy in Model 2

Parameter name	Wald test result (p-value)
P	11.099*** [0.000]
$\beta_{'E}$	11.059*** [0.001]
$\beta_{ə}$	3.512*** [0.008]
$\beta_{ç}$	2.284*** [0.003]
φ_1	14.323*** [0.002]
ω_0	3.519*** [0.009]
λ_0	2.633*** [0.433]
θ_0	5.520*** [0.000]

Note: P values are indicated in square brackets. ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively. Source: Compiled by the authors.

Table 9
Results of the Quantile Granger Causality Test for Causal Relationships between Indicators in Model 2.

Quantile	$\Delta Ę_{t}$ ↓ $\Delta 'E_{t}$	$\Delta 'E_{t}$ ↓ $\Delta Ę_{t}$	$\Delta Ę_{t}$ ↓ $\Delta ç_{t}$	$\Delta ç_{t}$ ↓ $\Delta Ę_{t}$	$\Delta Ę_{t}$ ↓ $\Delta Ə_{t}$	$\Delta Ə_{t}$ ↓ $\Delta Ę_{t}$
[0.05−0.95]	0.000	0.000	0.000	0.000	0.000	0.000
0.05	0.000	0.000	0.000	0.000	0.000	0.000
0.10	0.000	0.000	0.000	0.000	0.000	0.000
0.20	0.000	0.000	0.000	0.000	0.000	0.000
0.30	0.000	0.000	0.000	0.000	0.000	0.000
0.40	0.000	0.000	0.000	0.000	0.000	0.000
0.50	0.000	0.000	0.000	0.000	0.000	0.000
0.60	0.000	0.000	0.000	0.000	0.000	0.000
0.70	0.000	0.000	0.000	0.000	0.000	0.000
0.80	0.000	0.000	0.000	0.000	0.000	0.000
0.90	0.000	0.000	0.000	0.000	0.000	0.000

Source: Compiled by the authors.

Granger (Granger, 1969). More generally, the Granger causality test assumes that the current value of the dependent variable is determined by itself and the lagged values of the independent variable. In this study, the Granger causality test was applied to the analysed indicators, and the results are presented in Table 6. The results of the Granger causality test revealed robust bidirectional causality among the variables across all quantiles, ranging from 0.05 to 0.95. This indicates that the development and implementation of the sharing economy positively impacts all studied indicators. This effect was particularly significant for variables such as national and regional energy efficiency, energy prices, national GDP, and per-capita GDP.

We consider it appropriate to examine the second model using the QARDL methodology. Notably, the second proposed model is identical to the first model presented above, and the included variables are statistically significant. The adjustment speed coefficient $\rho_*(\tau)$ demonstrated significance and negative values across all quantiles. The indicators examined in this model—energy efficiency, energy prices, population growth, and the sharing economy—demonstrate a tendency towards long-term equilibrium. Below, we present the key findings of the evaluation of the second model. The main results obtained during the analysis are summarised in Table 7 and Fig. 2.

The data obtained from the analysis indicate that the sharing economy contributes to positive dynamics in improving energy efficiency, particularly in terms of energy intensity. This conclusion is supported by the observed negative impact of the sharing economy on energy intensity, which is significant only at higher quantiles (0.80−0.95). In this context, the implementation of a sharing economy creates conditions for increased energy efficiency by maximising returns from available resources and reducing losses during use. Consequently, Hypothesis 2 is rejected. This conclusion is generally consistent with the findings of researchers, who have noted that the introduction of a sharing economy enhances the efficiency of all types of energy resources, reduces waste, and reduces the emissions of environmentally harmful substances generated by industries and households (Adaktilos et al., 2018; Podgayskaya, 2017; Polterovich, 2016), leading to a decrease in the ecosystem's carbon footprint (Dabbous & Tarhini, 2021; Leismann et al., 2013).

In this context, based on the data obtained from this study, it can be asserted that under current conditions, the implementation of the sharing economy is becoming a key factor in the development of Russia's economic system. In the long term, it could serve as the foundation for modernising consumption mechanisms and forms by providing consumers with access without the need for ownership, while also reducing negative anthropogenic effects on the environment through increased energy efficiency. Importantly, our findings indicate a consistently negative impact of energy prices on energy intensity across all quantiles. Therefore, we can confirm the validity of the conclusion that rising energy prices are a factor in reducing energy consumption volumes, and ultimately lead to the development of more efficient models and mechanisms for utilisation. These findings are consistent with those of several Russian and international authors, such as Valko (2021); Valko et al. (2020), Avdokushin et al. (2019), Rebyazina et al. (2020); Filipović et al. (2015); Fitrianto and Iskandar (2019), and Rajbhhandari and Zhang (2018). The results obtained from our study also confirm the validity of the assertions found in the works of Russian and international authors, such as Seregina et al. (2019), Orlova et al. (2016), Tishchenko et al. (2019), Avtar et al. (2019), Kaushal (2018), and De Vita et al. (2006). These studies argue that population growth has a consistently positive effect on the energy intensity of the national economy, which is observed only in the lower and middle quantiles. As the population increases, so do the volumes of energy and energy carriers consumed, which inevitably lead to higher energy intensity and decreased energy efficiency.

Similarly, for the second model, we conducted a Wald test to check the consistency of the included parameters. The results of this test are presented in Table 8.

Based on the results of the Wald test, the null hypothesis H0 regarding the linearity of the ECM parameters was evaluated. Additionally, the test revealed a stable and significant impact of the integrating coefficients of energy efficiency and sharing economy. This indicates a long-term relationship between these indicators, although they vary in magnitude across quantiles. Importantly, significant p-values were observed in several quantiles, suggesting a similarity in the values of the coefficients for energy prices and population dynamics in these quantiles.

In line with Model 1, we performed a Granger causality test for Model 2. The results of this test are listed in Table 9.

The results presented in Table 9 indicate a stable bidirectional Granger causality between energy efficiency and all other studied variables. This allows us to assert that indicators such as energy prices, population dynamics, and sharing economy are significant for achieving the goal of enhancing energy efficiency in Russia's economic system.

Results

The empirical results of this study indicate that the development and implementation of the sharing economy under the current conditions is a critical factor in addressing the key challenges essential to achieving Russia's economic development goals. Specifically, it plays a significant role in shaping and achieving sustainable development goals in the production and consumption sectors. It is also evident that the development and implementation of a sharing economy address the crucial theoretical and practical issue of finding an optimal balance between enhancing economic growth and managing the constraints of limited resources that significantly influence this growth. This underscores the growing importance of government decisions in stimulating and supporting projects within this new form of economic interaction. These results highlight the need to expand legislative and regulatory support from the state to facilitate the development and implementation of a sharing economy. A distinctive feature of the sharing economy is the transfer of unused assets through C2C (consumer-to-consumer) interactions facilitated by digital platforms. Despite the advanced information and communication infrastructure and widespread availability of internet and mobile communications in Russia, the development of sharing economy services lags behind that of developed countries. We identified the following issues as obstacles to creating favourable conditions for establishing peer-to-peer relationships on digital platforms:

- Low level of trust in institutions in general and social services in particular.
- The presence of information inequality across different age groups and settlements of various sizes.

The relatively low-income population limits the development of social and environmental motivations.

Nonadaptation of existing state regulation measures to the realities of a peer-to-peer digital economy.

This study demonstrates that the unique characteristics of the sharing economy necessitate the adaptation of state regulatory frameworks in Russia in the following areas:

- Oversight into the quality of goods and services.
- Collection of information on the income of service participants and their taxation.
- Limitations of monopolistic power in the service sector.

It is important to note that these considerations are pertinent not only to Russia but also to the global community. To stimulate the accelerated adoption of the sharing economy as a factor in the development of Russia's economic system, the implementation of the following support measures is, in our opinion, advisable:

1. Development of digital regional infrastructure to broaden the user base of digital platforms in the sharing economy.
2. Improvement of institutional framework for the development of the sharing economy, specifically by formalising the legal status of transactions and new forms of employment.
3. Alignment of tax legislation that regulates economic transactions involving digital technologies.
4. Implementation of national and regional cybersecurity policies to ensure user safety during transactions conducted via digital platforms and to maintain a high level of trust.

The results obtained from this study substantiate the assertions of previous researchers that the implementation of a sharing economy under contemporary conditions is a crucial factor in reducing carbon dioxide emissions and environmental pollution. This issue is highly relevant not only for Russia, but also for the entire world. The volatility of prices for traditional energy sources and their persistently high levels, with a tendency towards further increases in the cost of renewable energy sources, underscores the importance of finding more effective solutions in the areas of energy consumption stability and quality, economic growth, and energy prices. This challenge is significant for all countries but is particularly critical for developing nations, including

Russia. In this context, the results obtained from the analysis of Model 2, in which we examined the interconnection and mutual influence between the sharing economy and energy efficiency, population dynamics, and energy prices, enabled us to draw several conclusions that may be of interest to government authorities responsible for implementing resource efficiency enhancement programmes in Russia. Under current conditions, it is evident, and this is corroborated by our research findings, that energy prices must, on the one hand, be set at levels that meet the energy needs of all sectors of the national economy, and, on the other hand, must incentivise the implementation of programmes aimed at improving the efficiency of energy resource utilisation.

It is essential to emphasise that the primary contribution to the reduction in energy intensity of the Gross Domestic Product (GDP) comes from structural shifts in the economy and recovery growth in industry. Currently, the potential of the current cycle of structural changes to further reduce energy intensity is largely exhausted. Technological savings are constrained by a lack of investment, the insufficient effectiveness of state policies aimed at mobilising such investments, and limited motivation among energy consumers to enhance energy efficiency. Consequently, the energy intensity levels of production for key domestic industrial products are 1.2 to 2 times higher (worse) than the global average and 1.5 to 4 times higher than the best global practices. This low energy efficiency results in a high proportion of energy costs among production costs and consequently diminishes the competitiveness of Russian products. Development of energy conservation and enhancement of energy efficiency in energy-consuming sectors are key conditions for forecasting the future development of Russia's fuel and energy complex (FEC). According to the measures proposed by the authors, with average annual GDP growth rates of 2–3%, the average rate of energy consumption growth is expected to be between 1.4% and 1.6%. This reduction in the energy intensity of the GDP by a factor of 1.3 to 1.5 (or an equivalent of 315–580 million tons of conditional fuel per year) is anticipated to be achieved as follows:

Two-thirds (215–390 million tons of conditional fuel) will result from the structural reorganisation of the Russian economy and the accelerated growth of less energy-intensive sectors such as manufacturing, construction, and services. This corresponds to a reduction in the share of raw materials and energy-intensive sectors by 3–4 percentage points by 2035.

- One-third (100–190 million tons of conditional fuel) will be achieved through technological modernisation and development.

Specifically, by 2035, the reduction in specific fuel consumption in the transport sector is projected to be 13% under a conservative scenario and 15% under an optimistic scenario owing to the optimisation of internal combustion engines and the use of new materials in automobile manufacturing. Additionally, the reduction in specific fuel consumption at power plants is expected to be 8–10% owing to planned equipment upgrades. In this context, it is crucial to address the task of maximising the potential for energy conservation and enhancing energy efficiency across all sectors of the economy, bringing it closer to the best global practices. Solving this task involves refining the state management system in the areas of energy conservation and efficiency improvement and creating significant incentives to attract both private and public investment in this field. To achieve this, it is essential to employ both existing mechanisms (such as concessions, energy service contracts, tax incentives, and other benefits) and new tools that have proven effective in international practice, as well as novel tools for Russia. These tools include targeted agreements with major energy consumers, private venture funds, revolving funds, and innovative financial instruments. According to global practice, financing measures for energy conservation and efficiency improvement can be sourced from tariffs and price regulations, provided socially justified constraints on growth are considered. This necessitates the application of long-term incentive-based regulatory methodologies across all infrastructure sectors, beginning with the strategic planning phase and extending to the formulation of specific tariff decisions for regulated infrastructure organisations. This approach should be implemented both at the federal level and within the constituent entities of the Russian Federation, considering the need to enhance the reliability and quality of energy supply, as well as to improve the operational efficiency of energy sector entities.

To realise the potential for energy conservation and efficiency improvements, the following measures should be implemented:

Enhancement of the regulatory framework. This includes bans on the production and use of energy-inefficient equipment, machinery, buildings, and technological processes.

Tax and non-tax incentives for companies to adopt the best available technologies (BAT), including the development and use of BAT directories and registries for technical and environmental regulation, and the purchase of energy-efficient equipment.

Utilisation of various levels of government budgets, extrabudgetary funds, and development institutions' resources to organise preferential loan financing for energy efficiency and conservation projects, including interest rate subsidies for relevant loans.

- Provision of government guarantees for loans used to implement energy conservation and efficiency projects.
- Development of energy efficiency standards for buildings, structures, equipment, machinery, and transportation.
- Improvement of Russian procurement legislation concerning the procurement of goods, works, and services to create conditions conducive to the implementation of energy conservation projects and the acquisition of energy-efficient equipment.
- Promotion of energy conservation and efficiency among various population groups, including higher education curricula.

Conclusion

Despite the persistent increase in the significance of projects and programmes aimed at developing the sharing economy in Russia, the role and specifics of their integration into the processes of achieving sustainable development goals and ensuring high levels of energy efficiency remain underexplored in management science. In recent years, the economic growth structure of Russia has undergone qualitative changes. Although a significant portion of Russia's energy structure comprises clean energy sources, such as nuclear power and hydroelectric energy, continued reliance on fossil fuels poses a substantial threat to the sustainability of economic development and energy consumption. In this context, the results of the present study lead to the conclusion that the development and implementation of a sharing economy, can play a decisive role in enhancing the efficiency of all types of energy resource consumption. Furthermore, this is becoming an increasingly significant factor in achieving sustainable economic growth in Russia's economic system. The primary objective of this study is to investigate and evaluate the presence of interrelationships and mutual influences among the sharing economy, energy-efficiency projects, and sustainability of economic development in Russia using the QARDL estimation methodology. Two models were developed for the empirical assessment. Model 1 evaluated the interrelationships and mutual influences between sustainable development projects and factors such as sharing economy, population dynamics, inflation, and unemployment rates. Model 2 assessed the interrelationships and mutual influences between the development and implementation of a sharing economy and energy efficiency within the economic system, considering factors such as energy prices and population dynamics. The findings of this study assert that the development and implementation of a sharing economy are becoming increasingly significant factors in addressing the challenges of achieving energy efficiency and sustainable development within Russia's economic system. The application of the QARDL methodology revealed positive interrelationships and mutual influences between the development and implementation of the sharing economy and the achievement of sustainable development goals across all quantiles. However, a similar level of interrelationship and mutual influence between the sharing economy and energy efficiency within the economic system of Russia was observed only in higher quantiles (0.80−0.95). Additionally, the research established that all the factors included in the study are significant, both positively and negatively, for achieving the development goals and ensuring energy efficiency in Russia's economic system.

The conclusions drawn regarding ways to promote the development and implementation of the sharing economy with a view to achieving the development goals in the Russian economy constitute a significant contribution to the current body of knowledge in this field. Our theoretical analysis addresses the gap in the international discourse on management sciences, in which the specific aspects of leveraging the Russian sharing economy for sustainable development purposes have been underexplored. A theoretical understanding of Russia's experience with the establishment and development of a sharing economy provides a basis for pursuing sustainable development goals. This perspective allows us not only to identify striking parallels with similar processes in other countries and validate the universal nature of principles proposed in previous academic and practical studies but also to outline the distinctive paths of progress inherent in Russia's approach to this initiative. On a practical level, our research findings and insights gained from analysing the Russian experience can serve as a valuable resource for academics, entrepreneurs, and policymakers seeking to develop strategies for exploring the intricacies of using the sharing economy as the basis for promoting sustainable economic growth in their own contexts. It is important to note in the conclusion that the present study has several limitations. The primary focus of this research is to identify and evaluate the interrelationship and interdependence between the development of the sharing economy and projects aimed at enhancing energy efficiency and sustainable development within Russia's economic system. From theoretical and practical perspectives, it is essential to focus on the following aspects in future research:

1. Exploring the unique characteristics of the strategies aimed at promoting the development and implementation of a sharing economy, which forms the basis for achieving sustainable economic growth in Russia.
2. Developing methodological frameworks for comparative analysis to comprehensively examine the distinctive features of sharing economy initiatives and their role in promoting sustainable development paths in Russia and other prominent economies such as BRICS countries, Southeast Asia, the Middle East, the European Union, and the United States.
3. This study conducts a comparative analysis of the specific features of platform economy integration, employment on platforms, and the sharing economy in the context of achieving sustainable development goals and energy efficiency objectives. The analysis focuses on Russia, the BRICS countries, Southeast Asia, the Middle East, the EU, and the USA.

The achievement of these research goals will enable us to conduct a comprehensive comparative analysis of the development and implementation of various aspects of economic systems in major countries, both across national boundaries and within integration associations, such as those in which the countries under study are members. Moreover, this approach will enable us to identify critical areas for improving these aspects of economic development, which could potentially increase the efficiency of not only individual national economies but also foster the creation of new mechanisms for international collaboration and provide a basis for the theoretical and practical study of these processes. We suggest employing methodological approaches and evaluation tools, such as MMQR, CS-ARDL methodologies, and NARDL estimations for these studies.

CRediT authorship contribution statement

Mikhail Vladimirovich Khachaturyan: Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Evgeniia Valeryenva Klicheva:** Visualization, Validation.

References

Abubakari, Y. (2021). The reasons, impacts and limitations of cybercrime policies in Anglophone West Africa: A review. *Przestrzen Spoleczna (Social Space), 21*(1), 137–158.
Adaktilos, A. D., Chaus, M. S., & Moldovan, A. A. (2018). Sheringovaya ekonomika [Sharing economy]. *Economics [Economics], 4*(36), 95–100. In Russ.
Adaramola, A. O., & Dada, O. (2020). Impact of inflation on economic growth: Evidence from Nigeria. *Investment Management and Financial Innovations, 17*(2), 1–13. https://doi.org/10.21511/imfi.17(2).2020.01
Adom, P. K. (2015). Determinants of energy intensity in South Africa: Testing for structural effects in parameters. *Energy, 89*, 334–346. https://doi.org/10.1016/j.energy.2015.05.125
Afanasyev, A. A. (2022). Forecast of the values of the main indicators of foreign trade in the context of the formation of a limited open economy of Russia. *Economic Relations*, (4), 635–650. https://doi.org/10.18334/eo.12.4.115163
Akinnifesi, E. O. (1986). Unemployment and economic development in Nigeria-Analysis and policy implications. *Economic and Financial Review, 24*(2), 52–63.
Akram, R., Majeed, M. T., Fareed, Z., Khalid, F., & Ye, C. (2020). Asymmetric effects of energy efficiency and renewable energy on carbon emissions of BRICS economies: Evidence from nonlinear panel autoregressive distributed lag model. *Environmental Science and Pollution Research, 27*(15), 18254–18268. https://doi.org/10.1007/s11356-020-08353-8
Ala-Mantila, S., Ottelin, J., Heinonen, J., & Junnila, S. (2016). To each their own? The greenhouse gas impacts of intra-household sharing in different urban zones. *Journal of Cleaner Production, 135*, 356–367. https://doi.org/10.1016/j.jclepro.2016.05.156
Ali, S. A., Alharthi, M., Hussain, H. I., Rasul, F., Hanif, I., Haider, J., & Abbas, Q (2021). A clean technological innovation and eco-efficiency enhancement: A multi-index assessment of sustainable economic and environmental management. *Technological Forecasting and Social Change, 166*, Article 120573. https://doi.org/10.1016/j.techfore.2021.120573
Aliu, Y., & Hajdini, A. (2021). Examining the challenges before public employment service in Republic of Kosovo. *Croatian International Relations Review, 27*(88), 34–52.
Alshahrani, S. T. (2021). Operating in a new paradigm: Exploring workplace reconfiguration in the time of covid-19. *International Journal of eBusiness and eGovernment Studies, 13*(2), 281–303.
Alsoud, A. R., Balhareth, H., Abd Hamid, J., Al-Masaeed, S., & Tham, J (2021). Educaional disruption and innovative teaching during the pandemic: An empirical study. *Educational Sciences: Theory & Practice, 21*(4), 1–16. https://doi.org/10.18778/0867- 5856.31.2.05
Amaladoss, M. X., & Manohar, H. L. (2013). Communicating corporate social responsibility−A case of CSR communication in emerging economies. *Corporate Social Responsibility and Environmental Management, 20*(2), 65–80. https://doi.org/10.1002/csr.287
Anghel, M.-G., Anghelache, C., & Manole, A. (2017). The effect of unemployment on economic growth. *Romanian Statistical Review Supplement, 65*(7), 174–186.
Avdokushin, E. F., & Kuznetsova, E. G. (2019). Ekonomika sovmestnogo potrebleniya: sushchnost i nekotorye tendentsii razvitiya [The economy of shared consumption: the essence and some development trends]. *Economic Journal, 2*(54), 6–19. https://doi.org/10.24411/2072-8220-2019-00010. in Russian.
Avtar, R., Tripathi, S., Aggarwal, A. K., & Kumar, P. (2019). Population−urbanization−energy nexus: A review. *Resources, 8*(3), 136. https://doi.org/10.3390/resources8030136
Barbier, E. B., & Burgess, J. C. (2019). Sustainable development goal indicators: Analyzing trade-offs and complementarities. *World Development, 122*, 295–305. https://doi.org/10.1016/j.worlddev.2019.05.026
Bashroush, R., Woods, E., & Noureddine, A. (2016). ICT Energy Demand: What got us here won't get us there! *IEEE Software, 33*(2), 18–21. https://doi.org/10.1109/MS.2016.53
Boar, A., Bastida, R., & Marimon, F. (2020). A systematic literature review. Relationships between the sharing economy, sustainability and sustainable development goals. *Sustainability, 12*(17), 6744. https://doi.org/10.3390/su12176744
Belk, R. (2014). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research, 67*(8), 1595–1600. https://doi.org/10.1016/j.jbusres.2013.10.001
Bolobonova, M. O., & Khrupalov, V. A. (2020). Pravovoye regulirovaniye oborota dannykh v deyatel'nosti tsifrovykh platform: spornyye voprosy teorii i praktiki [Legal regulation of data circulation in the activities of digital platforms: controversial issues of theory and practice]. *Business, Management and Law, 2*(46), 42–46. In Russian.
Boons, F., Montalvo, C., Quist, J., & Wagner, M. (2013). Sustainable innovation, business models and economic performance: An overview. *Journal of Cleaner Production, 45*, 1–8. https://doi.org/10.1016/j.jclepro.2012.08.013
Buchholz, T., Luzadis, V. A., & Volk, T. A. (2009). Sustainability criteria for bioenergy systems: Results from an expert survey. *Journal of Cleaner Production, 17*, S86–S98. https://doi.org/10.1016/j.jclepro.2009.04.015

Chang, B. H., Bhutto, N. A., Turi, J. A., Hashmi, S. M., & Gohar, R. (2021). Macroeconomic variables and stock indices: an asymmetric evidence from quantile ARDL model. *South Asian Journal of Business Studies, 10*(2), 242–264. https://doi.org/10.1108/SAJBS-09-2019-0161

Cho, J. S., Kim, T.-h., & Shin, Y. (2015). Quantile cointegration in the autoregressive distributed-lag modeling framework. *Journal of Econometrics, 188*(1), 281–300. https://doi.org/10.1016/j.jeconom.2015.05.003

Ciegis, R., Ramanauskiene, J., & Martinkus, B. (2009). The Concept of Sustainable Development and Its use for Sustainability Scenarios. *Engineering Economics, 2*, 28–37.

Coroama, V. C., & Hilty, L. M. (2014). Assessing Internet energy intensity: A review of methods and results. *Environmental Impact Assessment Review, 45*, 63–68. https://doi.org/10.1016/j.eiar.2013.12.004

Curtis, S. K., & Lehner, M. (2019). Defining the sharing economy for sustainability. *Sustainability, 11*(3), 567. https://doi.org/10.3390/su11030567

Cyrek, M., & Fura, B. (2019). Employment for sustainable development: sectoral efficiencies in EU countries. *Social Indicators Research, 143*, 277–318. https://doi.org/10.1007/s11205-018-1970-8

Dabbous, A., & Tarhini, A. (2021). Does sharing economy promote sustainable economic development and energy efficiency? Evidence from OECD countries. *Journal of Innovation & Knowledge, 6*(1), 58–68. https://doi.org/10.1016/j.jik.2020.11.001

Darity, W., Jr, Addo, F. R., & Smith, I. Z. (2021). A subaltern middle class: The case of the missing "Black bourgeoisie" in America. *Contemporary Economic Policy, 39*(3), 494–502. https://doi.org/10.1111/coep.12476

Das, K. (2019). The role and impact of ICT in improving the quality of education: An overview. *International Journal of Innovative Studies in Sociology and Humanities, 4*(6), 97–103.

De Vita, G., Endresen, K., & Hunt, L. C. (2006). An empirical analysis of energy demand in Namibia. *Energy Policy, 34*(18), 3447–3463. https://doi.org/10.1016/j.enpol.2005.07.016

Demailly, D., & Novel, A.-S. (2014). The sharing economy: Make it sustainable. *Studies, 3*(14), 14–30.

Digilina, O. B., & Mironova, T. G. (2018). Economics of shared consumption in Russia and abroad. *Russia and Asia, 4*(5), 33–42.

Diep, L. T. N., & Hieu, V. M. (2021). Examining quality of English language learning of university students in Vietnam: The moderating role of competition factor. *Eurasian Journal of Educational Research, 95*, 55–79. https://doi.org/10.14689/ejer.2021.95.4

Dolgova, M. V., & Dryazgina, E. S. (2015). Ekonomika sovmestnogo potrebleniya kak novaya biznes-model [Sharing economy as a new business model]. *Finance, Money, Investments, 3*(55), 13–18. in Russian.

Dolgova, M. V. (2018). Competitiveness of the business model of the economy of shared consumption. *Finance, Money, Investments, 4*(68), 8–12.

Dritsakis, N., & Stamatiou, P. (2016). The effects of unemployment on economic growth in Greece. An ARDL bound test approach. *The Romanian Economic Journal, 19*(62), 53–72.

Elkington, J. (1994). Towards the sustainable corporation: Win-win-win business strategies for sustainable development. *California Management Review, 36*(2), 90–100.

Fagerstrøm, A., Pawar, S., Sigurdsson, V., Foxall, G. R., & Yani-de-Soriano, M. (2017). That personal profile image might jeopardize your rental opportunity! On the relative impact of the seller's facial expressions upon buying behavior on Airbnb™. *Computers in Human Behavior, 72*, 123–131.

Fedorova, O. I. (2022). Shering-potreblenie kak importirovannyy institut v rossiyskoy ekonomike. *Ekonomika, Predprinimatelstvo i parvo, 12*(2), 649–660. https://doi.org/10.18334/epp.12.2.114218. №[in Russian].

Filipović, S., Verbić, M., & Radovanović, M. (2015). Determinants of energy intensity in the European Union: A panel data analysis. *Energy,, 92*, 547–555. https://doi.org/10.1016/j. energy.2015.07.011

Fitriyanto, F., & Iskandar, D. D. (2019). An analysis on determinants of energy intensity in ASEAN countries. *Jurnal Ekonomi dan Studi Pembangunan, 11*(1), 90–103. https://doi.org/10.17977/um002v11i12019p090

Ganapati, S., & Reddick, C. G. (2018). Prospects and challenges of sharing economy for the public sector. *Government Information Quarterly, 35*(1), 77–87. https://doi.org/10.1016/j. giq.2018.01.001

Geissinger, A., Laurell, C., Öberg, C., & Sandström, C. (2019). How sustainable is the sharing economy? On the sustainability connotations of sharing economy platforms. *Journal of Cleaner Production, 206*, 419–429. https://doi.org/10.1016/j.jclepro.2018.09.196

George, C. (1999). Testing for sustainable development through environmental assessment. *Environmental Impact Assessment Review, 19*(2), 175–200. https://doi.org/10.1016/S0195-9255(98)00038-9

Godil, D. I., Yu, Z., Sharif, A., Usman, R., & Khan, S. A. R. (2021). Investigate the role of technology innovation and renewable energy in reducing transport sector CO2 emission in China: A path toward sustainable development. *Sustainable Development, 29*(4), 694–707. https://doi.org/10.1002/sd.2167

Gong, M., Simpson, A., Koh, L., & Tan, K. H. (2018). Inside out: The interrelationships of sustainable performance metrics and its effect on business decision making: Theory and practice. *Resources, Conservation and Recycling,, 128*, 155–166. https://doi.org/10.1016/j.resconrec.2016.11.001

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society, 37*(3), 424–438. https://doi.org/10.2307/1912791

Gritsaenko, G. I. (2022). The role of human capital in sustainable economic development. Bulletin of DonNU, Ser. V. *Economics and Law, 3*, 64–73

Harun, S. A., Fauzi, M. A., Kasim, N. M., & Wider, W. (2022). Determinants of energy efficient appliances among malaysian households: Roles of theory of planned behavior, social interaction and appliance quality. *Asian Economic and Financial Review, 12*(3), 212–226. https://doi.org/10.55493/5002.v12i3.4463

Hasker, W. (2021). The trinity and the new testament a counter-challenge to Dale Tuggy. *European Journal for Philosophy of Religion, 13*(1), 179–199. https://doi.org/10.24204/ejpr.v13i1.3671

Hernawati, E., Hadi, A. R. A., Aspiranti, T., & Rehan, R. (2021). Non-performing financing among islamic banks in Asia-pacific region. *Cuadernos de Economía, 44*(126), 1–9. https://doi.org/10.32826/cude.v1i126.501

Hieu, V. M., Tai, T. D., & Hung, D. D. P. (2021). Examining the impact of sustainable energy on the economy: Panel evidence from ASEAN. *International Journal of Management and Sustainability, 10*(1), 22–32. https://doi.org/10.18488/journal.11.2021.101. 22.32

Hsu, C-C (2023). The role of the core competence and core resource features of a sharing economy on the achievement of SDGs 2030. *Journal of Innovation & Knowledge, 8*(1), Article 100283. https://doi.org/10.1016/j.jik.2022.100283

Hussain, S., Yu, C., & Wan, L. (2021). Energy − Growth Nexus- a case of South Asian countries. *Asian Journal of Economics and Empirical Research, 8*(2), 58–66. https://doi.org/10.20448/journal.501.2021.82.58.66

Hussain, H. I., Kamarudin, F., Anwar, N. A. M., Ali, M., Turner, J. J., & Somasundram, S. A. (2023). Does income inequality influence the role of a sharing economy in promoting sustainable economic growth? Fresh evidence from emerging markets. *Journal of Innovation & Knowledge, 8*(2), Article 100348. https://doi.org/10.1016/j.jik.2023.100348

Ishtiryakova, L. K., & Zaynullina, M. R. (2024). Theoretical aspects of the sharing economy in the context of institutionalism. *Creative Economy, 18*(3), 751–764. https://doi.org/10.18334/ce.18.3.120739

Javid, M., & Khan, M. (2020). Energy efficiency and underlying carbon emission trends. *Environmental Science and Pollution Research, 27*(3), 3224–3236. https://doi.org/10.1007/s11356-019-07019-4

Jelinkova, M., Tetrevova, L., Vavra, J., & Munzarova, S. (2021). The Sharing economy in the context of sustainable development and social responsibility: The example of the Czech Republic. *Sustainability, 13*(17), 9886. https://doi.org/10.3390/su13179886

Jin, C., Razzaq, A., Saleem, F., & Sinha, A. (2021). Asymmetric effects of eco-innovation and human capital development in realizing environmental sustainability in China: evidence from quantile ARDL framework. *Economic Research-Ekonomska Istraživanja, 35*(1), 4947–4970. https://doi.org/10.1080/1331677X.2021.2019598

Karobliene, V., & Pilinkiene, V. (2021). The sharing economy in the framework of sustainable development goals: Case of European Union Countries. *Sustainability, 13*(15), 8312. https://doi.org/10.3390/su13158312

Kaushal, L. A. (2018). The sharing economy and sustainability: A case study of India. *Valahian Journal of Economic Studies, 9*(2), 7–16. https://doi.org/10.2478/vjes-2018-0013

Kireeva, N. S., Zavyalov, D. V., Zavyalova, N. B., & Saginova, O. V. (2021). Transformatsiya sheringovoy ekonomiki v usloviyakh pandemii COVID-19 [Transformation of the sharing economy in the context of the COVID-19 pandemic]. *Ekonomika, Predprinimatelstvo i parvo, 11*(2), 213–226. https://doi.org/10.18334/epp.11.2.111614

Kostin, K. B., & Khomchenko, E. A. (2021). The current state of international technology transfer in the global economy. *Economic Relations*, (2), 411–424. https://doi.org/10.18334/eo.11.2.112111

Khusyainov, T. M., & Urusova, E. A. (2017). Ot obschestva potrebleniya k ekonomike sovmestnogo polzovaniya [From society of consumption to the economy of sharing]. *Philosophy of the Economy*, (6), 132–146. Russian.

Kleshcheva, O. A. (2017). Osobennosti rascheta effektivnosti innovatsiy s uchetom zatrat na okhranu okruzhayushchey sredy. *Voprosy Innovatsionnoy Ekonomikii, 7*(4), 381–390. https://doi.org/10.18334/vinec.7.4.38622. №.

Leismann, K., Schmitt, M., Rohn, H., & Baedeker, C. (2013). Collaborative consumption: Towards a resource-saving consumption culture. *Resources, 2*(3), 184–203.

Leung, X. Y., Xue, L., & Wen, H. (2019). Framing the sharing economy: Toward a sustainable ecosystem. *Tourism Management, 71*, 44–53.

Longoni, A., & Cagliano, R. (2018). Sustainable innovativeness and the triple bottom line: The role of organizational time perspective. *Journal of Business Ethics, 151*(4), 1097–1120.

Lydeka, Z., & Karaliute, A. (2021). Assessment of the effect of technological innovations on unemployment in the European Union Countries. *Engineering Economics, 32*(2), 130–139. https://doi.org/10.5755/j01.ee.32.2.24400

Madurapperuma, W. (2016). Impact of inflation on economic growth in Sri Lanka. *Journal of World Economic Research, 5*(1), 1–7.

Maheswaranathan, S., & Bhavan, T. (2022). Does a long-run relationship exist between trade openness and carbon dioxide emissions in Sri Lanka? *Asian Development Policy Review, 10*(3), 165–173. https://doi.org/10.55493/5008.v10i3.4547

Mahmood, T., & Ahmad, E. (2018). The relationship of energy intensity with economic growth: Evidence for European economies. *Energy Strategy Reviews, 20*, 90–98. https://doi.org/10.1016/j.esr.2018.02.002

Martos-Carrión, E.; Miguel, C. Chapter 2: The sharing economy history, definitions and related concepts. In The sharing economy and the tourism industry. perspectives, opportunities and challenges; Taheri, B., Rahimi, R., Buhalis, D., Eds.; Goodfellow Publishers: Oxford, UK, 2022. https://doi.org/10.23912/9781915097064-5094.

Mattayaphutron, S., & Mahamat, N. (2021). The determinants of persistence poverty: Case of agricultural households in Thailand. *AgBioForum, 23*(2), 135–142.

Markova, V. D. (2018). *Cifrovaja ekonomika* (p. 186). Russ: Moscow Publ..

Mi, Z., & Coffman, D. M. (2019). The sharing economy promotes sustainable societies. *Nature Communications, 10*(1), 1–3.

Mikušová, M. (2017). To be or not to be a business responsible for sustainable development? Survey from small Czech businesses. *Economic Research, 30*(1), 1318–1338. https://doi.org/10.1080/1331677X.2017.1355257

Mohseni, M., & Jouzaryan, F. (2016). Examining the effects of inflation and unemployment on economic growth in Iran (1996-2012). In *, 36. Procedia Economics and Finance* (pp. 381–389).
Muñoz, P., & Cohen, B. (2017). Mapping out the sharing economy: A configurational approach to sharing business modeling. *Technological Forecasting and Social Change, 125*, 21–37. https://doi.org/10.1016/j.techfore.2017.03.035
Nawaz, M. A., Seshadri, U., Kumar, P., Aqdas, R., Patwary, A. K., & Riaz, M. (2021). Nexus between green finance and climate change mitigation in N-11 and BRICS countries: Empirical estimation through difference in differences (DID) approach. *Environmental Science and Pollution Research, 28*(6), 6504–6519. https://doi.org/10.1007/s11356-020-10920-y
Nazir, S., Mahmood, N., & Hameed, G. (2022). Output and substitution elasticities in Pakistan's industrial sectors: Panel data analysis. *The Economics and Finance Letters, 9* (2), 257–272. https://doi.org/10.18488/29.v9i2.3180
Nozari, M. A., Ghadikolaei, A. S., Govindan, K., & Akbari, V. (2021). Analysis of the sharing economy effect on sustainability in the transportation sector using fuzzy cognitive mapping. *Journal of Cleaner Production, 311*, Article 127331. https://doi.org/10.1016/j.jclepro.2021.127331
Orlova, G. A., & Zelenyuk, A. N. (2016). Razvitie «Dolevoy» ekonomiki [Development of the «share» economy]. Rossiyskiy vneshneekonomicheskiy vestnik. *[Russian Foreign Economic Journal], 8*, 3–12. Russ.
Paraschiv, D.-M., Manea, D.-I., Ţiţan, E., & Mihai, M. (2021). Development of an aggregated social inclusion indicator. Disparities in the European Union on inclusion/exclusion social determined with social inclusion index. *Technological and Economic Development of Economy, 27*(6), 1301–1324. https://doi.org/10.3846/tede.2021.15103
Parente, R. C., Geleilate, J.-M. G., & Rong, K. (2018). The sharing economy globalization phenomenon: A research agenda. *Journal of International Management, 24*(1), 52–64. https://doi.org/10.1016/j.intman.2017.10.001
Parshakov, P., Shakina, E., & Barajas, A. (2021). Testing the contestable market theory in eSports. *Economic Research-Ekonomska Istrazivanja, 35*(1), 1–15. https://doi.org/10.1080/1331677X.2021.1889389
Peng, S. (2023). Sharing economy and sustainable supply chain perspective the role of environmental, economic and social pillar of supply chain in customer intention and sustainable development. *Journal of Innovation & Knowledge, 8*(1), Article 100316. https://doi.org/10.1016/j.jik.2023.100316
Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica: Journal of the Econometric Society, 57*(6), 1361–1401. https://doi.org/10.2307/1913712
Podgayskaya, A. (2017). Ekonomika sovmestnogo potrebleniya: zarybezhnyy i otechestvennyy opyt [Economy of joint consumption: foreign and domestic experience]. *Obshchestvo i ekonomika [Society and Economy]*, (2).
Polterovich, V. M. (2016). Pozitivnoye sotrudnichestvo: faktory i mekhanizmy evolyutsii [Positive cooperation: factors and mechanisms of evolution]. *Voprosy ekonomiki [Economic Issues]*, (11), 5–23.
Popov, E. V., & Veretennikova, A. Yu. (2019). Institutional support of a shared economy in urban development. *Journal of Institutional Studies, 11*(2), 44–59.
Popova, I. V., & Khuseynova, A. A. (2017). «Uberizatsiya» rossiyskoy ekonomiki: tsel, nedostatki, preimuschestva, perspektivy ["Uberization" of russian economy: purpose, weaknesses, advantages and prospects]. *Molodoy issledovatel Dona, 4*(7), 165–168.
Pouri, M. J., & Hilty, L. M. (2018). Conceptualizing the digital sharing economy in the context of sustainability. *Sustainability, 10*(12), 4453. https://doi.org/10.3390/su10124453
Pouri, M. J., & Hilty, L. M. (2021). The digital sharing economy: a confluence of technical and social sharing. *Environmental Innovation and Societal Transitions*, (38), 127–139. https://doi.org/10.1016/j.eist.2020.12.003
Rajbhandari, A., & Zhang, F. (2018). Does energy efficiency promote economic growth? Evidence from a multicountry and multisectoral panel dataset. *Energy Economics, 69*, 128–139. https://doi.org/10.1016/j.eneco.2017.11.007
Rebyazina, V., Berezka, S., & Antonova, N. (2020). Consumer's attitude to the sharing economy in Russia. *Russian Journal of Management, 18*, 255–278. https://doi.org/10.21638/spbu18.2020.206
Rozhkov, E. V. (2022a). Ispol'zovaniye zemli v granitsakh munitsipal'nogo obrazovaniya, kak polozhitel'nyy opyt upravleniya krupnym gorodom [Land use within the boundaries of the municipality as a positive experience in managing a large city]. *Bulletin of the Council of Young Scientists and Specialists of the Chelyabinsk Region, 1*(1), 69–75 (36)Russian.
Rozhkov, E. V. (2022b). Opportunity to change the future or "institutional trap. *Vestnik Universiteta, 1*, 113–121. https://doi.org/10.26425/1816-4277-2022-7-113-121
Rowley, K. M., & Feather, N. T. (1987). The impact of unemployment in relation to age and length of unemployment. *Journal of Occupational Psychology, 60*(4), 323–332. https://doi.org/10.1111/j.2044-8325.1987.tb00264.x
Ryzhkova, M., & Glukhov, A. (2020). *Resistance to digitalization in different segments of digital platforms users: An empirical study, 30* pp. 522–531). Bulletin of Baikal State University. https://doi.org/10.17150/2500-2759.2020.30(4).522-531
Sahnoun, M., & Abdennadher, C. (2019). Causality between inflation, economic growth and unemployment in North African countries. *Economic Alternatives, 1*, 77–92. https://ideas.repec.org/a/nwe/eajour/y2019i1p77-92.html.
Salikhov, B. V., & Semenov, A. V. (2019). The essence of sustainable development: definition of key concepts and qualitative integrity. Bulletin of the S.Yu. Witte Moscow University. *Series 1: Economics and Management,, 3*(30), 7–14. https://doi.org/10.21777/2587-554X-2019-3-7-14
Schor, J. (2016). Debating the sharing economy. *Journal of Self-Governance and Management Economics, 4*(3), 7–22. https://doi.org/10.22381/JSME4320161
Seregina, V. V., & Seredina, M. N. (2019). Sovremennye tendentsii razvitiya ekonomiki sovmestnogo potrebleniya (sherng-ekonomiki) v Rossii [Current trends in the development of the sharing economy in Russia]. *Nauchno-metodicheskiy elektronnyy zhurnal «Kontsept» [Koncept], 11*, 154–159. https://doi.org/10.24411/2304–120X-2019–14060. Russ.
Shair, F., Shaorong, S., Kamran, H. W., Hussain, M. S., Nawaz, M. A., & Nguyen, V. C. (2021). Assessing the efficiency and total factor productivity growth of the banking industry: Do environmental concerns matters? *Environmental Science and Pollution Research, 28*(16), 20822–20838.
Sharif, A., Godil, D. I., Xu, B., Sinha, A., Khan, S. A. R., & Jermsittirarsert, K. (2020). Revisiting the Role of Tourism and Globalization in Environmental Degradation in China: Fresh Insights from the Quantile ARDL Approach. *Journal of Cleaner Production, 272*, 1–12. https://doi.org/10.1016/j.jclepro.2020.122906
Sharko, E. R. (2020). Business development in a shared consumption economy. *Social Innovations and Social Sciences, 2*, 116–126. https://doi.org/10.31249/sn/2020.02.06
Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2011). Modelling asymmetric cointegration and dynamic multipliers in an ARDL framework. In William C. Horrace, & Robin C. Sickles (Eds.), *Festschrift in honor of Peter Schmidt* (Eds.). New York (NY): Springer Science & Business Media.
Shrestha, M. B., & Bhatta, G. R. (2018). Selecting appropriate metodological framework for time series data analysis. *The Journal of Finance and Data Science, 4*(2), 71–89. https://doi.org/10.1016/j.jfds.2017.11.001
Shu, X., Li, M., Ma, Z., & Qureshi, M. A. (2022). The asymmetric effect of film and drama industry, energy efficiency and economic growth on green innovation: Empirical evidence from quantile estimation. *Economic Research-Ekonomska Istrazivanja, 35*(1), 1–18. https://doi.org/10.1080/1331677X.2022.2032784
Sileika, A., & Bekeryte, J. (2013). Theoretical issues of relationship between unemployment, poverty and crime in sustainable development. *Journal of Security and Sustainability Issues, 2*, 59–70.
Škare, M., Kostelić, K., & Jozičić, K. (2013). Sustainability of employee productivity as a presumption of sustainable business. *Economic Research-Ekonomska Istraživanja, 26* (sup1), 311–330. https://doi.org/10.1080/1331677X.2013.11517654
Skavitin, A. V. (2018). *Udalennaya zanyatost: Obzor Praktik v Rossii* (pp. 102–107). [Remote employment: a review of practices in Russia]. HrRussian.
Skavitin, A. V. (2021). Lean manufacturing tools in a construction company: the experience of a national project. In *Problems of economics and construction management in the context of environmentally oriented development. Proceedings of the X Internationa Scientific and Practical Online Conference. Irkutsk-Bratsk-Tomsk, April 26-27, 2021* (pp. 452–458). Irkutsk: Baikal State University.
Slatten, L. A., Bendickson, J. S., Diamond, M., & McDowell, W. C. (2021). Staffing of small nonprofit organizations: A model for retaining employees. *Journal of Innovation & Knowledge, 6*(1), 50–57. https://doi.org/10.1016/j.jik.2019.06.002
Strizhakova, E. N., & Strizhakov, D. V. (2022). The sharing economy: A new economic model. *National Interests: Priorities and Security, 18*(2), 300–320. https://doi.org/10.24891/ni.18.2.300
Sukhodolov, A. P., & Timofeev, S. V. (2018). SMI i virtualnaya realnost: novye vozmozhnosti i perspektiv [Mass Media and Virtual Reality: New Opportunities and Prospects]. *Voprosy Teorii i Praktiki Zhurnalistiki, 7*(4), 567–580. https://doi.org/10.17150/2308-6203.2018.7(4).567-580. Russian.
Sun, Y., Yesilada, F., Zubaria, A., & Tahseen, A. (2021a). The role of eco-innovation and globalization towards carbon neutrality in the USA. *Journal of Environmental Management, 299*, 1–10. https://doi.org/10.1016/j.jenvman.2021.113568
Sun, Y., Ozlem, A. D., Asif, R., & Marius, S. D (2021b). The asymmetric effect eco-innovation and tourism towards carbon neutrality in Turkey. *Journal of Environmental Management, 299*, 1–9. https://doi.org/10.1016/j.jenvman.2021.113653
Surya, B., Syafri, S., Sahban, H., & Sakti, H. H. (2020). Natural resource conservation based on community economic empowerment: Perspectives on watershed management and slum settlements in Makassar City, South Sulawesi, Indonesia. *Land, 9*(4), 104.
Sutopo, B., Kot, S., Adiati, A. K., & Lina, N. (2018). Sustainability reporting and value relevance of financial statements. *Sustainability, 10*(3), 2–14. https://doi.org/10.3390/su10030678
Suwandaru, A., Alghamdi, T., & Nurwanto, N. (2021). Empirical analysis on public expenditure for education and economic growth: evidence from Indonesia. *Economies, 9*, 146. https://doi.org/10.3390/economies9040146
Szczuka, M. (2015). Social dimension of sustainability in CSR standards. *Procedia Manufacturing, 3*, 4800–4807.
Tagarov, B. Z. (2019). Evaluation of level of informatization of Russian companies. *Journal of International Economic Affairs, 9*(3), 2202–2212. https://doi.org/10.18334/eo.9.3.40729
Teslenko, I. B., Savelyev, I. I., & Tsarev, A. O. (2019). Economics of shared consumption: the essence and features. *Bulletin of the Academy*, (2), 5–13.
Tishchenko, N. Yu., Tishchenko, O. E., Rebyazina, V. A., & Slobodchuk, Yu. A (2019). *Faktory potrebitel'skogo povedeniya v sfere ekonomiki sovmestnogo potrebleniya v Rossii na primere kompanii Airbnb [Consumer behavior factors in the sharing economy in Russia: the case of Airbnb], 2* pp. 43–63). Vestnik Moskovskogo universiteta. Seriya 6. Ekonomika [Moscow University Economics Bulletin] (In Russ.).
Toni, M., Renzi, M. F., & Mattia, G. (2018). Understanding the link between collaborative economy and sustainable behaviour: An empirical investigation. *Journal of Cleaner Production, 172*, 4467–4477. https://doi.org/10.1016/j.jclepro.2017.11.110
Treptow, T. M. (2022). Log-elliptical tail distributions of power prices – Evidence from Germany and France. *Energy Economics Letters, 9*(2), 67–74. https://doi.org/10.55493/5049.v9i2.4577

Tretyak, O. A., Bilinkis, Yu. A., & Klimanov, D. E. (2021). The business model of the sharing economy: specifics, features and management challenges. *Russian Journal of Management, 19*(4), 403–428. https://doi.org/10.21638/spbu18.2021.402

Tu, Y.-T., Aljumah, A. I., Nguyen, S. V., Cheng, C.-F., Tran Tai, D., & Qiu, R. (2023). Achieving sustainable development goals through a sharing economy: Empirical evidence from developing economies. *Journal of Innovation & Knowledge, 8*(1), Article 100299. https://doi.org/10.1016/j.jik.2022.100299

Valko, D. V., & Maltseva, A. S. (2020). Sharing economy: Portrait of the Russian consumer. *Zhurnal Economicheskoj Teorii [Russian Journal of Economic Theory], 17*(3), 643–656. https://doi.org/10.31063/2073–6517/2020.17–3.10. In Russ.

Valko, D. V. (2021). Development of sharing economy and its impact on economic growth. *Zhurnal Economicheskoj Teorii [Russian Journal of Economic Theory], 18*(1), 56–68. https://doi.org/10.31063/2073-6517/2021.18-1.4

Veretennikova, A. Yu., & Kozinskaya, K. M. (2023). Neformalnaya institutsionalnaya sreda v razvitii platform shering-ekonomiki. *Voprosy Innovatsionnoy Ekonomiki, 13* (4), 2247–2268. https://doi.org/10.18334/vinec.13.4.119532

Vershitskiy, A. V., & Vershitskaya, E. R. (2017). Metody regulirovaniya ekonomiki sovmestnogo potrebleniya[Methods for regulating the economy of joint consumption]. *Journal of Economy and Entrepreneurship, 10-1*(87), 512–516. Russian.

Williams, C. C., & Horodnic, I. A. (2017). Regulating the sharing economy to prevent the growth of the informal sector in the hospitality industry. *International Journal of Contemporary Hospitality Management, 29*(9), 2261–2278. https://doi.org/10.1108/IJCHM-08-2016-0431

Xiao, Z. (2009). Quantile cointegrating regression. *Journal of Econometrics, 150*, 248–260.

Yilmaz, I. (2022). ESG-based sustainability performance and its impact on cost of capital: International evidence from the energy sector. *International Journal of Applied Economics, Finance and Accounting, 12*(2), 21–30. https://doi.org/10.33094/ijaefa.v12i2.529

Zenkina, E. V. (2021). Modern approaches to the countries sustainable development. RSUH/RGGU BULLETIN. *Series Economics. Management. Law*, (2), 111–125. https://doi.org/10.28995/2073-6304-2021-2-111-125. Russ.

Zhironkin, S., & Cehlár, M. (2022). Green economy and sustainable development: The outlook. *Energies, 15*(3), 1167.

Zhu, X., & Liu, K. (2021). A systematic review and future directions of the sharing economy: Business models, operational insights and environment-based utilities. *Journal of Cleaner Production, 290*, Article 125209.

Zivot, E., & Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics, 20*(1), 25–44.

Zmyslony, P., Leszczynski, G., Waligora, A., & Alejziak, W. (2020). The sharing economy and sustainability of urban destinations in the (over) tourism context: The social capital theory perspective. *Sustainability, 12*(6), 2310.