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Development of Regulatory Strategies in the Sharing Economy: The Application of Game Theory

Anna Y. Veretennikova * and Daria A. Selezneva

Institute of Economics, Ural Branch of Russian Academy of Science, Yekaterinburg 620014, Russia; dasha.sele@gmail.com
* Correspondence: veretennikova.au@uiec.ru

Abstract: Regulating the sharing economy is one of the most important aspects in the development of a business model that has developed rapidly due to the widespread adoption of digital technologies and is closely linked to the fast pace of institutional changes. The present study aims to develop strategies for regulating the sharing economy through the application of game theory. The authors identify common cooperative and non-cooperative strategies in the interaction of two participants: the state and the company. The matrix of strategies is based on the results of the analysis, which considers the interaction benefits, costs, and the positive and negative effects of this process. These strategies are exemplified in scenarios of interaction between the state and the sharing economy company in relation to three possible problems: environmental pollution, parking deficiency, and budget deficit. Furthermore, the study presents a comprehensive payoff matrix and provides a description of various sustainable and long-term scenarios. It also highlights the key parameters that should be taken into account when selecting a behavioral strategy for economic agents. In addition, the study establishes that supporting industries and projects of the sharing economy, as well as creating conditions or attracting investments, increasing public trust in government and business, and involving various social groups in resolving social problems are essential elements in the harmonious development of the sharing economy. These elements contribute to its potential to raise living standards. The practical significance of this study lies in the possibility of applying its results in the implementation of social and ecological objectives through the advancement of sharing economy initiatives.

Keywords: sharing economy; regulation; cooperation; non-cooperation; scenarios

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1. Introduction

The development of the sharing economy is accompanied by a rapid and transformational impact on many industries, including transportation (e.g., RelayRides, Uber, Lyft), hospitality (e.g., Airbnb), trade (e.g., Etsy, eBay), finance (e.g., Mintos, PeerBerry), and others (Xu 2020). The sharing economy has a high potential to change existing industries. On the one hand, it identifies new market niches and alternative ways of meeting the needs of economic agents (Zhang et al. 2019); on the other hand, it becomes a threat to the established models of economic activity (Pasternak-Malicka and Dębowski 2022).

Interest in this business model arose in the 2000s, primarily due to new opportunities provided by information and communication technologies (Belk 2007). At the same time, the sustainable development and transformation of attitudes toward consumption are no less important (Sadiq et al. 2023). The collaborative consumption of resources and the principle of sharing, together with the possibility of using digital technologies, has contributed to the formation of new forms of relations between economic agents based on creating and using digital platforms, which significantly reduce transaction costs (Dabbous and Tarhini 2021).

Discussion of the prospects and limitations of the development of the sharing economy presented in academic papers reflects the scale of the penetration of this business model into

economic activity both at the level of individuals and in the transformation of industries, as well as the formation of different levels and scales of ecosystems (Grondys 2019; Laamanen et al. 2016).

The rapid penetration of platform relationships, on which the sharing economy is based, requires new approaches to regulation. Outdated regulatory methods are likely to prove ineffective for the sharing economy. Under conditions of dramatic change in market conditions, the introduction of new technologies, and increased competition, public policy must evolve and adapt to the new reality in order to ensure timely regulation (Pawlicz 2019; Munkøe 2017).

Regulation of the sharing economy protects the rights and interests of participants in the interaction (Katz 2015). An environment where services are provided between individuals without the direct participation of companies poses a risk of unscrupulous participants violating the rules and failing to ensure the proper quality of services. In addition, the power of digital platforms and pressure on suppliers create the need for specific regulatory measures on the part of the state (Tremblay-Huet 2018).

The rapid speed of institutional changes, generated by the swift development of the sharing economy, is often perceived by traditional institutions and the state not only as a source of benefits but primarily as a threat. This perception leads to responses from the state in the form of restrictions and prohibitions. However, one of the principles embedded in the sharing economy consists of the principle of cooperation (Meng et al. 2020). As a basis of the sharing economy, peer-to-peer relations imply consideration of the interests of all economic agents involved in this interaction (Obushnyi et al. 2022). Thus, the state, on the one hand, has the right to set restrictions on the development of sharing services and sharing platforms, while on the other hand, in coordinated interaction with all interaction participants, the state also benefits from the additional effects caused by the release of additional resources and increased efficiency of their use (Hong and Lee 2020).

Developing strategies for regulating the sharing economy based on game theory allows for optimal approaches to regulation to be determined and the interests of all participants to be reconciled. State regulation of the sharing economy serves as an important tool for ensuring the sustainable and even development of this new form of economic relations. The implementation of effective regulation will create favorable conditions for the development of the sharing economy, thereby minimizing risks and maximizing benefits for all market participants and society as a whole. Thus, the present study aims to develop strategies for regulating the sharing economy through game theory.

The study involved the following: analysis of publications on the regulation of the sharing economy from the Scopus database; construction of a four-field matrix of strategies for the behavior of economic agents through the application of game theory; calculation of total benefits from interaction; identification of parameters to be considered when determining the strategy of behavior; as well as the designation of areas to be covered for the sustainable development of cooperative consumption strategies for boosting the sharing economy. The paper comprises seven sections. Section 2 outlines the primary regulations for the sharing economy presented in the research literature. In Section 3, cooperation and non-cooperation strategies within the sharing economy are discussed. Section 4 expounds on the research procedure. Section 5 presents a matrix of strategies of economic agents for three potential situations. The overall benefit matrix and potential strategy implementation directions are detailed in Section 6. Section 7 encompasses key conclusions and the significance of this study.

2. Approaches to Regulation of the Sharing Economy: Cooperation or Non-Cooperation

The principle of resource sharing, which lies at the core of the sharing economy, has become familiar over the last 20–25 years, although collaborative forms of consumption were present back in the 18th–19th centuries. However, the development of digital technologies marks a wider scale of spread and gives a new appearance to this model of behavior and resource consumption.

The concept of "collaborative consumption" was first used in 1978 by Felson and Spaeth (1978) when considering issues of community functioning. Benkler (2006), being a supporter of free exchange, studied sharing in the context of car sharing and exchange of information resources, scaling these processes to the processes of economic reproduction as a whole. In contemporary academic literature, the development of the term "sharing economy" is usually associated with the works of Lessig (2008), who directly introduced the term "sharing economy", as well as with the works of Botsman and Rogers (2010), who published a monograph detailing the concept of collaborative consumption and relevant digital platforms.

The sharing economy is considered a subset of the platform economy (Heerschap et al. 2018) and includes elements of the access economy and the community economy (Acquier et al. 2017). At the same time, the boundaries of this business model remain undefined and extremely blurred. For example, it can be understood as part of a circular economy in terms of extending the life of a product (Schwanholz and Leipold 2020) or considered as an exclusively market niche rather than a separate market. D. Schor, when considering the sharing economy, divides it into four categories: recycling of goods, wider use of durable assets, exchange of services, and sharing of productive assets (Schor 2014). We should also acknowledge the correlation between the sharing economy and the gig economy, both of which are facilitated through digital platforms. The gig economy can be regarded as a pool of labor resources for the sharing economy, as well as being directly based on the sharing of resources (Malik et al. 2021).

Due to the complexity and heterogeneity of the models in the sharing economy and collaborative consumption, there is also a scientific discussion about how appropriate it is to consider these concepts in tandem. For example, Luri Minami et al. (2021) substantiate that the sharing economy is mainly explained by internal reasons, while "collaborative consumption" is caused by external economic factors and the internal reason of pleasure. However, Zhu and Marjanovic (2021) demonstrate that the sharing economy is a complex phenomenon that encompasses various types. The authors reveal the advantages of platform cooperatives as one of the models considered within the sharing economy. The term "collaborative economy" is also used to describe short-term rental platforms in Eurostat. We stand by the position that the sharing economy can be considered in both narrow and broad interpretations (Heerschap et al. 2018); the broad interpretation allows us to study these concepts in tandem.

Publications from the Scopus database were used to study the regulation of the sharing economy. The queries presented in Table 1 were used for the search. Data on the number of articles found is presented in Table 1. When the terms "regulation" and "governance" are considered in tandem, the sharing economy can be considered not only as an object of regulation but, above all, as a business model to open up new opportunities for more effective management at various levels of economic activity. The "cooperative" strategy for projects of the sharing economy is claimed to be the most promising and relevant area for the development of this business model.

Table 1 presents the results of the analysis for the designated keywords in the Scopus and Google Scholar databases. The publications found in the Scopus database for these queries were analyzed using VosViewer software (version 1.6.20; developed by N. Jan van Eck and L. Waltman at Leiden University's Centre for Science and Technology Studies (CWTS), Leiden Netherlands) and are presented in Figure 1. Analysis of the identified keywords reveals the following blocks of publications: (1) studies related to the organization of platform functioning; (2) studies affecting regulatory issues in certain industries, in particular, tourism and transport; (3) studies on sustainable development and smart cities; and (4) general issues related to the legal and economic development of the sharing economy.

Table 1. Queries in the Scopus and Google Scholar databases.

	Number of Publications			
Query	**Scopus**		**Google Scholar**	
Search	Title, Abstract, Keywords	All Fields	Title	Article text
"Sharing economy" regulation	370	6788	168	46,400
"Sharing economy" governance	176	8129	104	43,100
"Collaborative economy" governance	22	1297	4	8020
"Collaborative economy" regulation	53	1094	10	11,400
"Collaborative consumption" regulation	28	1697	3	16,300
"Collaborative consumption" governance	11	2139	0	12,400

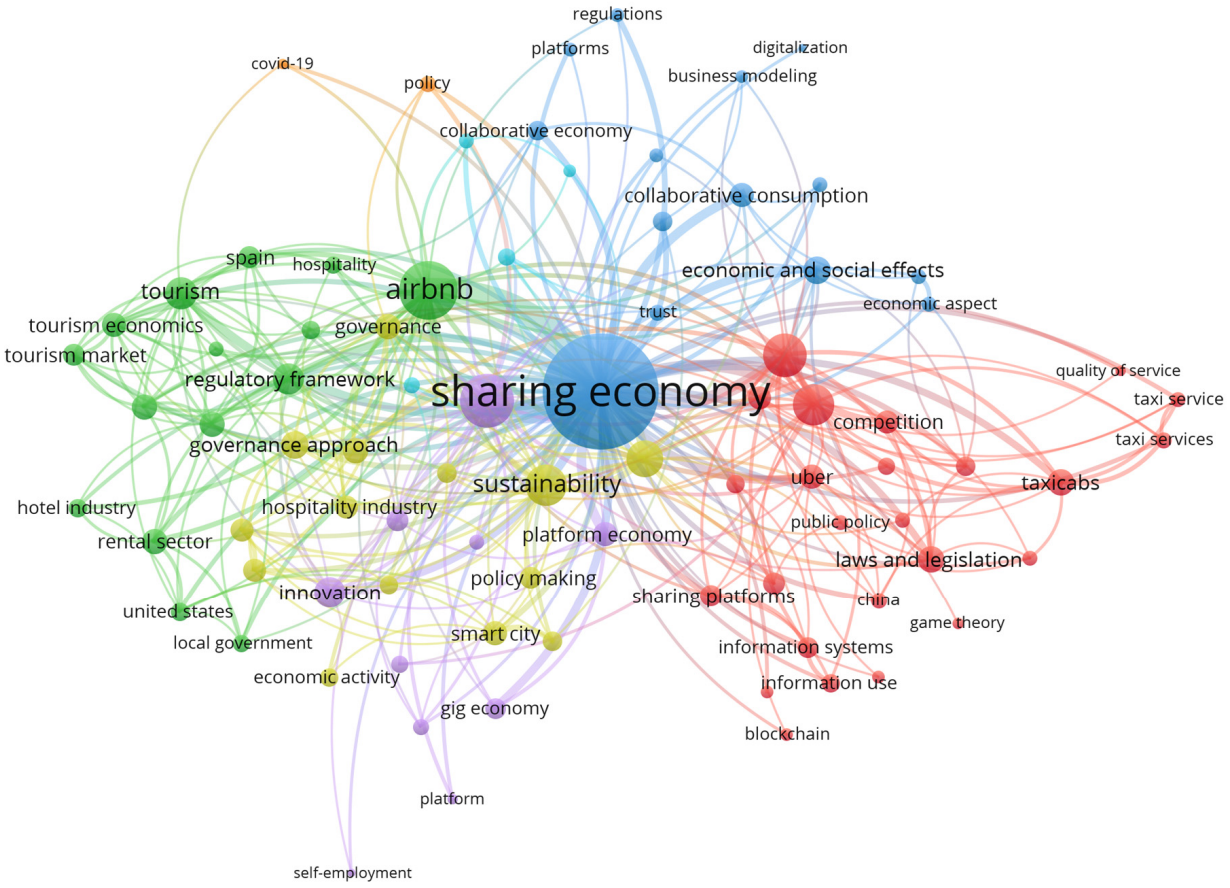

Figure 1. Results of research and publications analysis using the VosViewer software.

The first works on the regulation of the sharing economy date back to 2016, when S. Miller (Miller 2016) formulated 10 principles to be considered when developing regulatory measures. These principles encompass a broad array of facets concerning the development of the sharing economy, so let us explore them more comprehensively. The first principle claims that the sharing economy is differentiated and requires a differentiated regulatory response. In identifying this principle, Miller notes that the regulatory response should not be based on one-off deals with specific new market players. They should cover the diversity of players affected by the sharing economy. Regulators must determine the complexity of changes to respond effectively to them. The heterogeneity of the development of the sharing economy confirms this principle, as evidenced in the practical implementation of

individual regulatory measures, such as those for short-term rental platforms (Chen et al. 2020) and crowdlending platforms (Valiante 2022).

The second principle implies that the sharing economy needs to be highlighted and brought into the legitimized transactional world. S. Miller also notes that this activity should be legalized in order to protect the participants in the interaction and create opportunities for development. However, Pawlicz (2019) demonstrated that there are both pros and cons to regulating the sharing economy. For instance, while the benefits encompass addressing issues such as the monopolistic power of intermediaries, information asymmetry, external effects, and unfair competition, the cons include limiting innovations, addressing market problems, and others.

The third principle consists in providing the regulator with the requested information. This reduces uncertainty and establishes different types of discrimination in the provision of services. This principle is also important for the development of smart cities (Bernardi and Diamantini 2018).

The fourth principle implies that the sharing economy disrupts and reimagines established markets. However, changes can be more complex and affect not only a single industry but also related ones. S. Miller shows that AirBnB, while affecting the hotel business, also has an impact on transportation and tourist services. The scale of influence can extend to entire cities, for example, in terms of competition between territories for holding certain events. The fifth principle implies the sixth—the sharing economy creates new markets. The sharing economy essentially constitutes a new principle of consumption that can detect new niches with demand. Thus, the volume of rentals through Airbnb far exceeds the loss of market share observed by hotels. The spread and effectiveness of this business model form the seventh principle, implying that the sharing economy disrupts and reimagines established regulatory structures. The market of the sharing economy, in particular short-term rentals, has the potential to compete with hotel and tourist areas, which are currently considered mainly as places of temporary stay. The scale of the impact of the sharing economy on socioeconomic processes and population behavior defines the eighth principle: the sharing economy requires a response beyond traditional regulation. The informality of the sharing economy makes traditional methods of regulation ineffective, thereby necessitating the development of more flexible, cooperative models of interaction. The ninth principle consists of the difficulty of determining both the harm from the sharing economy and the cost of preventing it. The tenth principle refers to the need to consider all parties involved in the sharing economy. This business model, first of all, is built on the principles of collaboration, thereby requiring coordinated consideration of all participants. It follows that the sharing economy creates new markets, transforms existing ones, stimulates the development of legislation in this area, and requires more flexible regulations (Miller 2016).

Describing the entities that participate or may participate in the regulation of the sharing economy, S. Kirchner and E. Schussler emphasized the special role played by digital platforms as market organizers, as well as many other public and private actors, such as standard-setting organizations, social movements, trade unions, organized buyers and sellers, officials or persons influencing political decisions. Scholars note that regulatory solutions for the sharing economy depend on understanding the ways in which this business model is organized and that the emergence of digital platforms in the sharing economy comprises a highly organized process carried out by market organizers who create and manage digital marketplaces (Kirchner and Schüßler 2020).

Chen et al. (2020) considered the regulation of the sharing economy based on the example of short-term rental platforms. They note the importance of analyzing short-term results and, above all, long-term ones. Regulatory measures can be considered at several levels and can address the needs of the consumer, the utility, or the community that owns the leased premises, as well as at the industry level. Such measures include (1) standardizing the process in order to ensure the quality of the service provided; (2) recording the database of guest names, contact information, and dates of stay; (3) requiring property owners

to comply with basic standards regarding the health and safety of their guests and the requirement of civil liability insurance to cover the health and safety of guests; (4) ensuring only temporary use of premises for short-term rentals in order to maintain the supply and availability of housing in the real estate market; (5) setting limits on the number of nights available for rent; (6) requiring compliance with local laws on garbage, parking, noise, etc.; and (7) requiring to pay taxes on an equal basis with hotels etc.

When developing a strategy for sharing economy regulation, the impact of the sharing economy should be considered as a highly complex phenomenon. This is due to a significant transformation of specific markets, as well as changes affecting key economic indicators. For example, Cermakova et al. (2023) showed a growing regional inequality between homeownership and renting in the real estate market. The authors noted that the share of rental housing will gradually increase as the availability of own housing decreases. Price dynamics will differ depending on the development potential and attractiveness of individual regions. These trends will generate income inequality among the population, adversely affecting socioeconomic development. In addition, such changes will contribute to the transformation of the behavioral patterns of economic agents in the investment markets.

Significantly, regulation in the sharing economy has also contributed to the development of the concept of the "sharing city" (Bernardi and Diamantini 2018). This concept involves the design of smart cities using the principle of sharing. In this case, sharing refers primarily to data and then extends to other types of resources that can be involved in sharing. Here, state or municipal authorities become a regulator, as well as a customer and investor of a particular project. Such projects of the sharing economy can be used to develop public goods, smart cities, and to support entrepreneurial projects.

The review of research confirms the necessity of comprehensive regulation for sharing economy initiatives. This will enable the utilization of the benefits of the sharing economy in achieving social and ecological objectives while also mitigating the potential negative impacts of the described business model.

3. Cooperation and Non-Cooperation in the Sharing Economy

The issues of cooperation and non-cooperation in the sharing economy are closely related to the expected risks from this model of resource consumption and utilization. Trust is another important topic that determines the state's position regarding the development of the sharing economy. Trust constitutes a "key building block of society," thereby playing an important role in shaping interactions and relationships in the context of peer-to-peer markets and services (Hawlitschek et al. 2018). Issues of trust in the sharing economy are quite well covered in academic literature. According to the Scopus database, the first studies on trust in the sharing economy date back to 2012. M. Nunes and J. Correia covered trust-building issues on P2P platforms (Nunes and Correia 2012). Hawlitschek et al. addressed this topic by applying the theory of social identity. The scholars show that social presence in media spaces is a tool to ensure trust when interacting with other users (Hawlitschek et al. 2016). Ert et al. came to similar conclusions, demonstrating that if review scores vary experimentally, they affect visitor decisions, while the role of the host photo on the platform was also considered significant (Ert et al. 2016).

Meanwhile, the development of blockchain technology can significantly reduce the severity of this problem. Blockchain technology refers to the cryptographic distributed ledger methods with a decentralized mechanism. It provides proven and transparent mechanisms for registering and exchanging values without the need for a central governing body (Nakamoto 2008; Notheisen et al. 2017; Puschmann and Alt 2016). Blockchain technology, also called "trustless technology", is based on the idea of automatically creating an immutable, consensual, and publicly accessible record of past transactions governed by the entire system of alleviating trust issues in peer-to-peer systems (Greiner and Wang 2015). However, several studies (Hawlitschek et al. 2016) have shown that using blockchain technology to provide a "trustless system" raises the problem of trust in the algorithms underlying the blockchain. Ensuring trust in algorithms may require regulation, the

development of social norms, and the establishment of a common language between developers and lawyers.

In addition, the foundation of cooperation in the sharing economy is not necessarily trusted, but the duration of relations, during which the most successful behavior strategies and stable patterns of collaboration have been developed (Axelrod 2006). The idea of cooperation in the development of the sharing economy is reflected in its related concepts of "collaborative consumption" or "collaborative economy". When considering the interests of all stakeholders, the development of network relations and the emergence of appropriate effects necessitate the search for more effective models of behavior based on mutual cooperation; however, these forms may differ significantly depending on the consideration of economic, environmental, or social dimensions.

Cui L., Yang K., Lei Z., Lim M.K., and Hou Y. proposed an approach to analyzing the study of stakeholder cooperation by examining the stakeholder network structure and sustainability factors. Social motivation, security mechanisms, industry supervision, economic benefits, and level of cooperation are considered key factors for sustainable development. In addition, providers and platforms associated with the sharing economy can create economic and social value rather than environmental value (Cui et al. 2021).

Non-cooperation is outlined in works that have considered the threats to the development of the sharing economy. The benefits of the sharing economy with low prices, labor flexibility, and demand-driven transactions are reflected in the opposite pole: low wages, tax evasion, lack of social security rights, and regulatory uncertainty regarding requisite insurance, food, and fire safety (Ranchordás 2016). The sharing economy can also generate internet fraud, requiring special regulation and monitoring (Thomas et al. 2016). Corporations that use the sharing economy model also face obstacles. This influence can be exerted by governments, regulators, companies, and society, with requirements varying from country to country (Thornton et al. 2019).

Another important aspect that determines state strategies for the development of companies applying this business model relates to the level of social and economic development of the country, as well as the quality of life of its citizens (Lazzari et al. 2021). In particular, studies by Grybaite, Stankevičiene, and Sundararajan A. showed an identical character of motives for the development of sharing (Grybaite and Stankevičiene 2016; Sundararajan 2016). Thus, Martin, Plewnia, and Guenther focused on the potential of this business model to achieve social and environmental goals (Martin 2016; Plewnia and Guenther 2018). At the same time, economic opportunities and additional profits, as well as reducing transaction costs, constitute equally significant incentives for the development of the sharing economy.

In past years, many countries have developed and implemented regulatory measures for the sharing economy in order to ensure safety, protect consumer rights, maintain competition, and solve other social and economic issues. In the US, individual states and cities have taken steps to regulate the sharing economy, particularly taxis and popular platforms such as Uber and Lyft. For example, in New York, restrictions were imposed on the number of Uber and Lyft cars in order to combat market flooding and traffic congestion. Other states may have different regulations and licensing in order to ensure the safety and quality of services.

France has implemented a law requiring drivers on Uber and other platforms to register and obtain a professional license in order to ensure safety and compliance with regulations. In Germany, the regulation of the sharing economy is focused on consumer protection. In 2018, a Hamburg court declared Uber an illegal transportation service. It was banned from providing services in the country until certain requirements were met. In China, where major resource-sharing platforms such as DiDi Chuxing (similar to Uber) operate, the state imposes restrictions on the number of drivers, sets prices for rides, and conducts safety checks to prevent incidents and ensure consumer confidence.

4. Methodology

The research methodology involved the matrix approach applied in game theory to describe cooperative and non-cooperative strategies in the interaction of the state and sharing economy companies. Game theory is widely used in academic literature to analyze projects in the sharing economy. Pan. G. et al. simulate sharing transportation in order to analyze the cooperative model and income allocation model in three cooperative patterns based on evolutionary and dynamic games (Pan et al. 2021). R. Corten examines social dilemmas applicable to describing relations existing in the sharing economy (Corten 2019). In particular, the prisoner's dilemma is demonstrated as typical of the activities of digital platforms engaged in resale (Ebay, etc.) or aggregators. A trust game is another game with a place in platform sharing. This game has recently been realized within the development of online marketplaces (Przepiorka 2013; Resnick and Zeckhauser 2002; Tadelis 2016). The implementation of a transaction on the AirBnB platform is shown to be better modeled by the trust game since one party first makes a choice, and the other shapes its behavior depending on that choice. The trust game has been widely used to model economic transactions marked by information asymmetry (Akerlof 1970).

Cermakova et al. demonstrated the application of game theory in the development of the concept of the strategic cycle as a sound theoretical basis for explaining economic fluctuations. The authors proposed a model based on the principles of the Hawk–Dove game, where doves are peaceful and ready to share territory, while Hawks are aggressive and prefer conflict to cooperation in order to gain additional territory. Applying this logic to the present study, the cooperative strategies can be compared to the behavior of doves, while the non-cooperative strategies can be compared to the behavior of hawks (Cermakova et al. 2021).

This study considered the so-called game between the state and the sharing economy company, with the aim of determining their behavior in the regulation and development of sharing economy projects. This game is based on the prisoner's dilemma carefully described in game theory. The authors of the study take into account only two participants of this game: the state and the company implementing the sharing economy model. Civil society is actively involved in this interaction. However, it remains unaddressed in the study due to its apparent consideration by the state. Since this assumption can be regarded as a limitation of this model, the authors explore various interpretations of this thesis when discussing the results.

The state adopts two extreme strategies in this game: cooperative and non-cooperative. The state considers various options to cooperate with sharing economy companies by offering programs and tax incentives to encourage environmental and social responsibility. According to the state, this strategy may contribute to the development of a sustainable economic and environmental system and increased and improved living standards. In this case, the player discovers that supporting responsible and socially oriented companies can provide long-term benefits. Another option involves non-cooperation, where the state adopts tough measures, including strict regulations, high fines, and tax policies for sharing economy companies that fail to comply with environmental and social requirements. This strategy could provide the state with a means for preventing undesirable behavior and reducing negative impacts on the environment and living standards.

The state analyzes the potential outcomes of each of its strategies in order to choose the optimal option that is most beneficial for both the state and society. However, sharing economy companies and their strategies play an important role in the outcome of the game under study. Sharing economy companies are recognized as players who make strategic decisions following their interests and goals. Companies may choose a cooperative strategy involving cooperating with the state and participating in the design and implementation of social programs. They can actively introduce new technologies, cooperate, or provide services, contributing to the total utility and improving conditions for all participants.

When implementing a non-cooperative strategy, sharing economy companies are seeking to maximize their individual utility and profit while paying little attention to

environmental or social issues. Sharing economy companies analyze the potential outcomes of each of their strategies and strive to choose the optimal option that is most beneficial for their interests and goals. Their solutions make a significant impact on the outcome of the game and on the total utility of all participants.

The procedure for this study consisted of three steps. The first step embraced the identification of common cooperative and non-cooperative strategies in the interaction of two participants: the state and the company. Following the results of the analysis, the authors developed a matrix of strategies considering the interaction benefits, costs, and positive and negative effects of this process. When designing these strategies, the authors used the existing experience of sharing economy regulation in different countries, as presented in international Scopus-indexed studies included in Google Scholar. In addition, the Sharing Economy Index was used as a source of data on the development of the sharing economy. The Sharing Economy Index (2021) is compiled by the Consumer Choice Center (USA) and provides information on the development of sharing economy services at the city level. The reason for a high, or, on the contrary, low level of development of sharing economy services lies in the existing sharing policy in the territory under consideration. Analysis of scientific publications and measures to regulate sharing economy platforms enabled the authors to form a list of parameters that needed to be taken into account when considering this topic.

The second step reflected its application to public issues and involved describing the scenarios of interaction between the state and the sharing economy company in relation to three potential problems: environmental pollution, parking deficiency, and budget deficit. When determining the lists of areas, the authors considered, first of all, the underestimated potential of the sharing economy to resolve socially significant issues, as well as the significant impact of this phenomenon as one of the trends in the digital economy and, moreover, in the sustainable development of society. This became the basis for considering three aspects of the impact of the sharing economy: economic, social, and environmental.

Thirdly, the study calculated the general payoff matrix and indicated sustainable and long-term scenarios. The role thus demonstrated of the sharing economy in realizing the long-term scenario for the development of socioeconomic systems substantiates the need for the development of cooperative strategies. In addition, the authors identified parameters that need to be considered when choosing a behavior strategy for economic agents.

In the discussion of the results, the authors of the present paper define possible directions for the development of the sharing economy under the condition of choosing cooperative strategies.

5. Results

Following the results of the analysis, the authors developed a matrix of strategies, which considers the interaction benefits, costs, as well as positive and negative effects of this process. Each of the strategies includes an economic effect, expressed in the amount of tax for the state and in additional profit for the companies, as well as a positive or negative (or lack thereof) effect expressed in non-monetary terms (Table 2).

Table 2. Matrix of regulatory strategies in sharing economy projects.

		Sharing Economy Companies	
		Cooperation	Non-cooperation
State	Cooperation	$Bs = T - t - C_1 + E_s$; $Bc = NR - C_2 + t + E_c$	$Bs = T - C_1 - E_s$; $Bc = NR + R - E_c$
	Non-cooperation	$Bs = T - C_3 + F + E_s$; $Bc = NR - C_2 - F + E_c$	$Bs = T - C_3 + F - E_s$; $Bc = NR + R - F - E_c$

T—net tax paid by sharing economy companies. NR—net revenue of sharing economy companies. R—additional rent. C_1—program development costs. C_2—new technologies introduction costs for cooperation development. C_3—control costs. t—transfer payments. F—fines. E_s—intangible effects for the state. E_c—intangible effects for the company. Bs—general benefits for the state. Bc—general benefits for the company.

These strategies are considered in relation to three problems: environmental pollution, parking deficiency, and budget deficit. The cooperative and non-cooperative strategies, firstly, and intangible effects as their distinguishers, were defined for each of these problems.

5.1. Environmental Pollution

The first example of the above strategies will be considered in the case of environmental pollution in the territory under consideration. This condition comprises an external factor that affects the behavior of both players.

It is assumed that the state has the following behavior strategies to choose from:

Cooperative strategy: developing programs for sharing economy companies that encourage the use of electric vehicles or environmentally friendly technologies.

Non-cooperative strategy: imposing strict regulations and emission fines to reduce air pollution.

Sharing economy companies have the same following strategies to choose from:

Cooperation strategy: adopting clean technologies and providing electric vehicles to reduce emissions and improve the total utility for all participants.

Non-cooperation strategy: maximizing their individual utility by offering vehicles with lower rental costs and amenities unrelated to eco-efficiency.

The intangible effect of the state (E_s) means the contribution to the environmental state and sustainability of the territory. The intangible effect of the company (E_c) includes customer loyalty and corporate policy. Selecting one or another strategy implies the following four scenarios.

5.1.1. Scenario 1

The development of programs (C_1) to encourage the use of clean technologies and electric vehicles, as well as the allocation of transfers, will enable the state to reduce environmental pollution. The more efficient use of resources and reduction of emissions will contribute to better air quality and improve the environmental situation in the cities. The implementation of such measures leads to the improvement of public health and a reduction in the cost of medical treatment (E_s). The introduction of clean technologies (C_2) and the provision of electric vehicles by the companies will enable emissions to be reduced and the eco-efficiency of their services to be improved. Moreover, the image of the companies improves, thereby attracting more clients who value environmentally responsible solutions (E_c). In addition, such measures contribute to the sustainable development of companies and society as a whole.

5.1.2. Scenario 2

The development of programs to promote clean technologies and electric vehicles will fail to provide the expected results if the sharing economy companies select the non-cooperative strategy. The state may be faced with a poor cooperative attitude on the part of companies and their reluctance to participate in environmental initiatives. Therefore, the goals of reducing environmental pollution and improving the environment are difficult to achieve (E_s). Seeking ultimate individual utility and neglecting eco-efficiency can lead to prolonged environmental pollution. Companies may use cars with lower rental costs and amenities that are not necessarily related to environmental aspects. Consequently, companies generate additional rent (R) while air pollution increases, leading to reputational losses for the companies (E_c).

5.1.3. Scenario 3

The introduction of strict regulations and emissions fines will keep environmental pollution under more efficient state control. In addition, the state can raise revenue through fines (F) and invest it into ecological issues. However, this implies mandatory control over the sharing economy companies in this sphere (C_3). Developing environmental management solutions for companies leads to a reduction in emissions and improvement

of environmental performance (E_s). Other potential consequences include enhancing the reputation of the companies, an increasing number of customers who value environmentally responsible solutions, and the sustainable development of the companies in the long term (E_c). However, in this scenario, companies bear costs from increased fines, as well as the development and implementation of clean technologies (C_2).

5.1.4. Scenario 4

The introduction of strict regulations and emissions fines is a way of preventing environmental pollution and providing legal control for the companies. However, the companies' poor cooperative attitude could mean poor environmental performance (E_s). In order to take all the necessary measures, the state needs active cooperation and support from the companies. When companies select a non-cooperative strategy and avoid cooperation and mitigation measures, they generate additional profit but fail to prevent long-term environmental pollution. Violation of environmental regulations is considered to negatively affect the environment, human health, and image of the companies. In addition, companies may face negative public attitudes and government restrictions, including stricter regulations and sanctions (F).

5.2. Parking Deficiency

Parking deficiency is a social problem that lies at the root of the following example of the game. The state has the following behavior strategies to choose from:

Cooperative strategy: development of programs for sharing economy companies to encourage the use of designated parking spaces or the sharing of existing parking spaces with other companies.

Non-cooperative strategy: introduction of high fines for the improper parking of sharing cars.

Sharing economy companies have the same strategies to choose from as follows:

Cooperative strategy: collaboration with the state in the development of joint solutions to managing parking spaces and ensuring efficient use of resources. Potentially, it maximizes total utility by reducing parking deficiency and improving conditions for all participants.

Non-cooperative strategy: an ultimate increase in the number of cars in the city to meet demand and enhance individual utility, disregarding the potential parking deficiency and inconveniences for other participants.

The intangible effect of the state (E_s) consists of resolving the city problem, reducing parking deficiencies, and offering citizens satisfaction. The intangible effect of the company (E_c) includes an increase in the availability of parking spaces for customers and customer satisfaction.

Four outcomes might occur.

5.2.1. Scenario 1

The development of programs for sharing economy companies to encourage the use of designated parking spaces or the sharing of existing parking spaces with other companies will facilitate the state management of parking deficiency and ensure the efficient use of resources. Cooperation with companies will enable a balanced parking infrastructure to meet needs and demand, as well as contribute to improved public transportation. Cooperation with the state will enable companies to manage parking efficiently and minimize parking deficiencies. They will use the designated parking spaces or share existing parking spaces with other companies, ensuring the efficient use of resources and improving customer convenience. In addition, as a result of such cooperation, companies will maintain a positive image and good relationship with the state and community.

5.2.2. Scenario 2

When the state selects a cooperative strategy, and the sharing economy companies choose a non-cooperative strategy, the development of programs for sharing economy companies to encourage the use of designated parking spaces or sharing existing parking spaces with other companies will not provide a beneficial effect. This will be due to the poor response of the companies. The ultimate increase in the number of cars in the city enables companies to meet demand and maximize their individual utility and profits. However, it can lead to a parking deficiency and inconvenience for other participants, including city residents.

5.2.3. Scenario 3

The introduction of high fines for the improper parking of sharing cars will facilitate state control of the situation and deter the improper parking strategy of sharing economy companies. However, state non-cooperation may exacerbate relations with the companies and frustrate their cooperative attitude towards other projects. Consequently, cooperative solutions are hard to implement, and thus, it becomes less possible to develop an effective parking infrastructure. Cooperation between sharing economy companies and the state enables the companies to participate actively in the development of joint solutions for parking management. In order to cope with parking deficiency, the companies can advocate alternative approaches, such as the use of designated parking spaces or sharing the existing ones. However, in the case of state non-cooperation, companies may face restrictions and high fines, leading to their limited capacity and increased operating costs.

5.2.4. Scenario 4

The introduction of high fines for the improper parking of sharing cars will facilitate state control of the situation and deter improper parking strategies of sharing economy companies. However, state non-cooperation may create tensions and negatively affect the relationship between the state and the companies. The ultimate increase in the number of cars in the city along with a failure to provide sufficient parking space, may lead to parking deficiency and inconvenience for residents and drivers. As a result, growing negative public opinion, fines, and restrictions may reduce the individual utility and profit of the companies.

5.3. Budget Deficit

The budget deficit is another issue to consider. The state has the following behavior strategies to choose from:

Cooperative strategy: development of tax mechanisms to encourage sharing economy companies to invest in social programs.

Non-cooperative strategy: raising tax rates for sharing economy companies to increase revenue may lead to a higher financial burden and limited growth and development in the companies.

Sharing economy companies have the following strategies to choose from:

Cooperative strategy: voluntary participation in social programs aimed at solving public issues, regardless of tax payments.

Non-cooperative strategy: minimizing tax payments and using tax incentives to boost individual utility and profit.

The intangible effect of the state (E_s) includes the budget remedy and social development. The intangible effect of the company (E_c) consists in the reallocation of funds from tax expenditure to public needs and customer loyalty.

As for as Scenario 1 (Cooperation–Cooperation), the development of tax mechanisms (C_1) to encourage sharing economy companies to invest will motivate the companies to participate in solving public issues. The outcomes will include improving the quality of services and meeting public needs (E_s). Voluntary participation in social programs (C_2) aimed at resolving public issues and maximizing total utility will lead to increased

social responsibility of companies and a positive image among customers and society as a whole (E_c).

In Scenario 2, the development of tax mechanisms (C_1), which encourage sharing economy companies to invest in social programs, will reduce their implementation and efficiency in the event of companies' poor attitude to cooperating and investing (E_s). When companies choose the scenario with minimized tax payments and maximized individual utility and profit, they are most likely to retain a larger share of their net revenues (NR). However, their poor level of participation in social programs may eventually bring negative public opinion and reputational risks to companies, thus affecting their relationships with customers and public trust (E_c).

In Scenario 3, due to an increase in tax rates for sharing companies, the state will have to cope with the budget deficit and generate additional revenues (F). However, the state may face difficulties with upholding and complying with tax legislation (C_3). Moreover, the voluntary participation of companies in social and environmental programs ensures the improvement of public reputation (E_c) and satisfaction of public needs (E_s). In this scenario, companies spend additional funds on social programs (C_2) while paying higher tax rates (F).

In Scenario 4, where both sides choose not to cooperate, the state generates additional revenues by increasing tax rates for sharing economy companies (F) while bearing costs for control (C_3), and public issues remain unresolved (E_s). In order to minimize the tax payments and boost their net revenue (NR), the companies may take measures such as cutting costs, raising the price for their services, or evading tax laws. In this case, the companies cope with high tax rates (F), although the quality of their services and the attitude of their customers may be affected (E_c).

6. Discussion

6.1. Expected Payoffs and Algorithm for Selecting Strategies

The results of the general payoff analysis are presented in Table 3.

Table 3. General payoff matrix in the interaction of the state and the sharing economy company.

State	**Sharing Economy Companies**		
		Cooperation	Non-cooperation
	Cooperation	$(T + P) + (E_s + E_c) > C_1 + C_2$	$(T + NR + R) - (E_s + E_c) > C_1$
	Non-cooperation	$(T + P) + (E_s + E_c) > C_3 + C_2$	$(T + NR + R) - (E_s + E_c) > C_3$

Due to the calculation of the general payoff, the following results were obtained. The "Cooperation–Cooperation" strategy is certainly considered to be the optimal and most mutually beneficial option. This scenario takes into account the interests of both the company and the state. The participants in the interaction gain economic as well as intangible effects ($E_s + E_c$). Meanwhile, the implementation of this strategy implies significant investment, expressed as $C_1 + C_2$. The sustainability of this strategy and the long-term character of the cooperation could be ensured by an investor, as well as the fulfillment of the participants' interests.

The "Cooperation($_s$)–Non-cooperation ($_c$)" strategy appears sustainable in the short term. Its implementation suggests inadequate conditions for collaboration or a lack of trust in the state. When a company violates the established rules and regulations, the state may select the strategy of non-cooperation.

The "Non-cooperation ($_s$)–Cooperation($_s$)" strategy focuses mostly on short-term cooperation. However, the activity of business or civil society and their readiness to support intangible effects may ensure the sustainability of this strategy. Acquisition on the part of the state of intangible effects could be ensured by an investor or civil society activity.

The "Non-cooperation–Non-cooperation" strategy could endure until the negative effects become too high. Prior to this, the strategy can be sustainable.

In conclusion, it should be noted that the following parameters should be considered when selecting an interaction strategy:

- long-term or short-term period;
- type of benefits targeted by counterparties;
- amount of investment needed to implement the strategies;
- number of groups affected by the strategy in the long and short term;
- impact on civil society.

Based on these criteria, the choice of behavior strategy can be based on the following algorithm. This algorithm includes six successive steps, namely: (1) defining the goals of interaction (individual, public, mixed); (2) defining the period of interaction (long-term, short-term, medium-term); (3) analysis of players, their interests, and strategies of behavior (non-cooperation, cooperation); (4) defining gains and losses (social, economic, environmental), analysis of the impact on society, choosing a strategy of behavior.

6.2. Cooperation Strategies as a Way to Resolve Public Issues

This study considered a quite simple example of interaction between economic agents with only one representative of the sharing economy. Nevertheless, the actual, more complex regulatory processes need to take into account the applied models of the sharing economy, the nature of the market in terms of the number and size of organizations that provide sharing economy services, their inclusion in the ecosystems, as well as their affiliation to different industries.

Actions on the part of the state in terms of creating a favorable environment for the sharing economy development can be considered in the following areas:

1. Direct support of industries and projects of the sharing economy

The implementation of this strategy implies both direct and indirect forms of support. Moscow's experience of supporting car-sharing companies that meet certain criteria has contributed to reducing traffic and creating more favorable conditions for increasing individual mobility. This is recognized as one of the conditions for the development of "smart cities". Indirect support, for example, reducing the tax burden on these companies, also stimulates the development of the sharing economy. Nevertheless, the issue of ensuring accessibility of services provided by the sharing economy companies remains relevant and requires specific attention. International practice shows that the consumer of this type of service is an individual with an above-average income level. Thus, this business model will either develop on a competitive basis, making these services more affordable, or it will become a part of an ecosystem where using the service provided ensures certain advantages in other areas of consumption.

2. Creating conditions for attracting investments

The development of the sharing economy is considered an effective way of releasing underutilized resources. Thus, creating conditions for the development of this business model and increasing its competitiveness will attract investors to develop projects in this area. In addition, the sharing economy offers new investment and financing models, particularly the application of crowd-funding, crowd-lending, and crowd-investing platforms.

3. Increasing civil society's trust in the actions of the state and business

Since the sharing economy is based, first of all, on ensuring trust between the participants in the interaction, developing appropriate mechanisms is crucial for implementing sharing economy projects and cooperative strategies. Trust can be ensured through the promotion of appropriate values and the introduction of digital technologies. Thus, the use of blockchain technology eliminates the need to develop specific trust mechanisms due to the transparency of data.

4. Involvement of various social groups in resolving public issues

The willingness of citizens to participate in these projects is an integral condition for the development of the sharing economy. On the one hand, this topic is related to the trust issue, while on the other, to the accessibility of the services provided. In addition, the sharing economy's potential goes significantly beyond the boundaries of a single company or platform. The principle of relationships inherent in this business model implies peer-to-peer relations, thus aligning the interests of all participants. Building such systems and the corresponding relations requires significant transformation at all levels of the implementation of social and economic processes. This is also associated with significant changes in both formal and informal institutions. Notably, the high speed of the development of digital technologies accelerates institutional transformation. The transition from institutions of competition to institutions of co-opetition has already attracted academic interest (Brandenburger and Nalebuff 1996). However, moving towards these transformations is reflected both in the interaction of individual companies, for example, in the development of network relations or the formation of ecosystems, and at the level of countries. The development of such a concept as co-competition, as an example of an intermediate institution on the way from competition to cooperation, can be considered as one of the examples of movement in this direction. In addition, sharing city replication projects exemplifies such interaction.

The strategies presented, and the calculation of the overall benefits consider a large number of parameters, which ostensibly may seem obvious. The key difficulty in choosing the appropriate behavioral strategy on the part of both the state and companies lies in predicting the behavior of economic agents, which, in turn, will be determined by expectations regarding the behavior of the second player. In this case, the player's behavior can be either rational or of bounded rationality, something which also requires consideration. One of the approaches to resolving this issue is presented in the works of 2014 Nobel laureate J. Tirole, where the author proposes options for regulating and supporting companies operating in oligopolistic markets (Jean Tirole: Market Power and Regulation 2014), which will depend on the expectations and openness of the company itself. The development of such approaches objectively requires broad parameters to be considered. Nevertheless, the consistency of economic agents and the nature of the existing formal and informal institutional environment will remain key factors.

The impact of external challenges on the generation of supply and demand in markets with sharing economy companies should also be taken into account when considering this topic. This will modify the behavioral strategies of both the state and sharing economy companies. In particular, the global shocks associated with the spread of COVID-19 and geopolitical events causing significant migration flows require timely responses (Cermakova et al. 2023) and the high adaptability of a wide number of players and stakeholders. If, in the long term, we adhere to the effectiveness of "cooperation"–"cooperation" strategies, then in the short term and in order to stabilize the market, a "non-cooperation" strategy, which would imply stricter regulatory measures, may be more sustainable for the state. All the above confirms the deep penetration of sharing economy companies into socioeconomic processes, and the choice of the state strategy in this matter will be highly relevant, affecting living conditions and the quality of life of citizens.

7. Conclusions

The aim of this study was to develop strategies for regulating the sharing economy through the application of game theory. The following results were obtained.

Firstly, the study identified common cooperative and non-cooperative strategies in the interaction of two participants: the state and the company. A matrix of strategies was based on the results of the analysis and considered the interaction benefits, costs, as well as positive and negative effects of this process.

Secondly, the study demonstrated the application of this approach to resolving social problems; in particular, it described scenarios of interaction between the state and the

sharing economy company in relation to three potential problems: environmental pollution, parking deficiency, and budget deficit.

The study calculated the general payoff matrix and indicated sustainable and long-term scenarios. In addition, the authors identified parameters to consider when choosing economic agents' behavior strategies. The discussion part of the paper defined areas that need to be further examined in terms of the sustainable development of cooperative strategies. The study established that supporting industries and projects of the sharing economy, creating conditions for attracting investments, increasing public trust in state and business, and involving various social groups in solving social problems are essential elements in the harmonious development of the sharing economy. Their potential can be applied to raising living standards. The study also explored possible strategies of behavior based on the example of only two interaction participants. At the same time, the particular implementation of the sharing economy models in individual industries remains unconsidered.

The results identified herein lead us to the conclusion that employing cooperative strategies in the regulation of sharing economy initiatives creates new possibilities for addressing social and environmental issues, engaging both civil society and enterprises in this process. This, nevertheless, can be achieved if the interests of all stakeholders are considered, if there are available investments and if a flexible institutional environment is in place to adapt to rapidly changing conditions. In addition, the results obtained can be used in developing public–private partnerships and designing "smart cities". The outcomes provided broaden the theoretical exploration of the sharing economy by applying game theory to address social and environmental issues. The practical importance of this study lies in its potential to be utilized for realizing socially significant goals through the development of sharing economy initiatives.

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