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In search of the transaction costs in the bioeconomy

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Abstract: The ongoing changes in the natural environment caused by human activity require the societies of the 21st century to focus more on ways of protecting nature, as well as on the efficient use of available natural resources. One of the systemic solutions is the implementation of the bioeconomy concept. In the bioeconomy area, the entrepreneurial perspective plays a key role in ensuring that social and economic expectations are met along with protecting nature. This perspective can be seen in accordance with the New Institutional Economics theory, which stresses out that institutions create the essential framework for the activities in the economic system, especially in terms of costs of the transactions occurring therein. The main objective of this paper is to identify transaction costs in the bioeconomy as well as to describe the tools for their analysing. Based on the literature review focusing on transaction cost theory and empirical studies it was found that there is no one fits all approach. The transaction costs in bioeconomy can be measured directly and indirectly. The lack of a comprehensive approach to transaction costs in bioeconomy translates also into many possible research methods applied to measure them. Thus, the paper identifies the research gap for further elaboration.

Key words: New Institutional Economics; transaction costs; bioeconomy; sustainability

1 Introduction

Societies striving for economic development for many centuries didn't pay attention to the impoverishment of surrounding ecosystems. By using natural resources in many places, it has changed the surrounding landscape irreversibly. In the late 20th century and especially in the 21st century, the perception of the impact of human activities on the surrounding environment has changed. The evolution that has taken place in this area has made the transformation of economies and individual businesses towards the use of renewable resources an extremely important area. Anthropogenic changes in the environment have resulted in the paradigm of sustainable development, which is reflected in European and national legislation. Sustainable development, defined as development that meets the needs of the



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present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987), is consistent with the concept of bioeconomy.

The bioeconomy uses renewable biological resources from land, sea and waste to produce food, materials and energy (European Commission, 2018). The defined scope of the bioeconomy results in a wide range of enterprises within it. They operate in a variety of sectors with industry-specific legal environments. Simultaneously, social and economic expectations of creating value for consumers in the form of new or improved products and services that are also environmentally friendly influence how individual bioeconomy enterprises operate. Taking into account both legal, social and economic aspects, the institutional environment characteristic for the bioeconomy area is clarified.

Every area of the economy is shaped by a certain institutional environment that affects the way businesses operate. In addition to the framework imposed by law, the approach to the conduct of transactions between market participants is influenced by the specifics of the market. Researchers applying New Institutional Economics (NIE) theories use the institutional environment of companies and transaction cost theory to explain the functioning of the economic processes. Diversity within the bioeconomy, both in terms of the exact area of business and the size of the organization affects the nature of the transactions that take place and, consequently, the level of transaction costs. Transaction costs play an important role in the bioeconomy enterprises too.

This paper will conduct a literature review of both transaction cost theory and empirical research on transaction cost measurement dedicated to the broader bioeconomy sector. On this basis, the impact of transaction costs on the functioning of business entities in the bioeconomy sector will be illustrated. Through this, the author will attempt to identify the research gap in transaction costs analysis in the bioeconomy.

2 Methods

The main objective of the article is to present the importance of transaction costs in the context of the bioeconomy area and to indicate possible research methods that could be used. For this purpose, a literature review was applied to both the bioeconomy field and transaction cost theory. Methods for quantifying transaction costs in bioeconomy companies were also identified based on the desk research of empirical studies. The sources of the literature were scientific databases: Web of Knowledge, Scopus and Erih Plus.

3 Definition of a bioeconomy

More companies are operating in the bioeconomy sector causing an increase in the importance of this area to the economy (Cingiz et al., 2021). As Komor (2020) points out, the bioeconomy is a concept of resource-efficient development based on the management of renewable biological resources, whose challenge according to Adamowicz (2017) is also to integrate with the paradigm of sustainable development. The concept of bioeconomics also provides a framework for the different sectors and activities of the business on which the process of creating added value for the economic system of a country is based. The primary sectors forming the core of the bioeconomy include agriculture, forestry, and fisheries, which are the main sources of biomass, which is used to produce biofuels and bioenergy, as well as feed and bioproducts (Beluhova-Uzunova et al., 2019). Also linked to the industries that form the core of an economic system based on the use of renewable resources are the industrial processing sectors, which are responsible for the production of food, paper and pulp. The partial bioeconomy also includes elements of the chemical, pharmaceutical, and textile industries (Wąs et al., 2019). In the intermediate sphere of the bioeconomy, there are supporting sectors that serve a similar function to other economic sectors. Companies operating in this zone provide the necessary technology, machinery, products and services. Figure 1 shows the spheres of the bioeconomy.

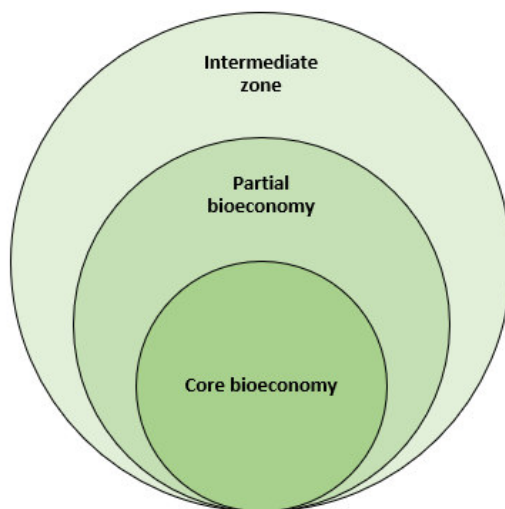


Figure 1 Bioeconomy spheres

Growing public awareness of climate change outlines a long-term view of bioeconomy development. Wessler (2015) indicates that the development of the bioeconomy will continue due to increasing globalization and ongoing progress in life sciences and information technology, as well as increasing volumes of inter-and



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intra-industry trade. At the same time, Maciejczak (2018) argues that the implementation of the idea of bioeconomy will solve the problems of modern economies such as the need to replace non-renewable resources with renewable ones or to counteract the overexploitation of the environment while ensuring an adequate quality of life for the growing population.

3.1 The importance of the bioeconomy for the European Union

As Pajewski (2014) underlines, the bioeconomy development strategy creates opportunities for global food security and smart product creation. It also supports agriculture, forestry, aquaculture and other ecosystem sectors to adapt to climate change. Czernyszewicz (2016) argues that implementing a bioeconomy strategy increases food chain efficiency. From the perspective of adapting societies and economies of the European Union to the ongoing climate change, the concept of bioeconomy is extremely important. The growth of this area of the economy is also evident in the value added generated, where the bioeconomy sectors generated €614 billion in 2017. Figure 2 shows the allocation by the source of value added from the bioeconomy area.

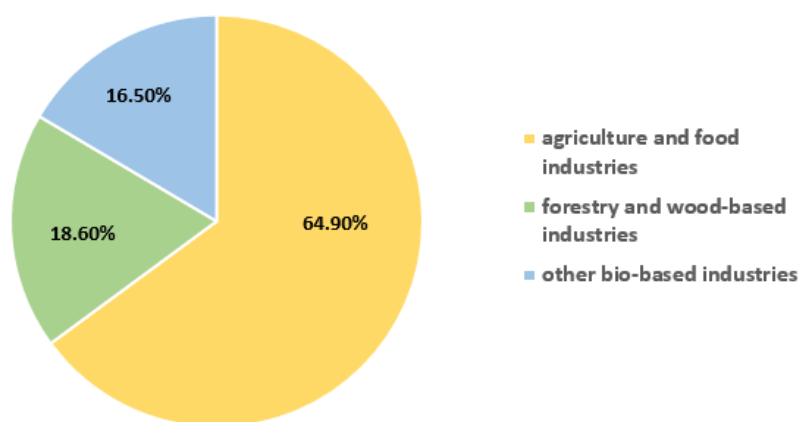


Figure 2 Value-added of the EU Bioeconomy

Source: https://knowledge4policy.ec.europa.eu/bioeconomy/monitoring_en Acces: 20.11.2021

The main source of added value for the European Union economy is the sector related to agriculture and food, which accounts for nearly 65% of the total. The bioeconomy area employed 17.5 million people in 2017. The greatest need for labor capital was in the area of agriculture, which employed nearly 78% of people. Figure 3 illustrates the structure of employment in the bioeconomy by main areas.



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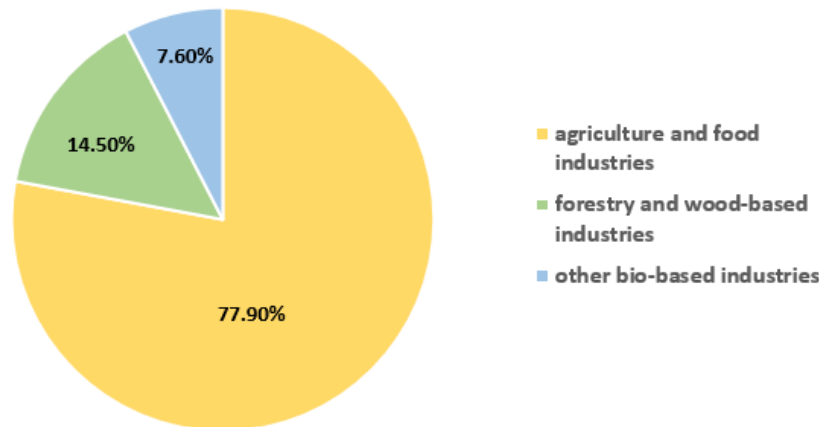


Figure 3 Employment in the EU Bioeconomy

Source: https://knowledge4policy.ec.europa.eu/bioeconomy/monitoring_en Acces: 20.11.2021

The bioeconomy plays an important role in the European Union, enabling economic development based on renewable resources. As Czyzewski and team (2021) point out, an important factor in the development of the bioeconomy is the well-developed qualifications and skills of the workforce. As the authors of the report *Future transitions for the Bioeconomy towards Sustainable Development and a Climate-Neutral Economy (2020)* note, the bioeconomy should be a priority area of the European Union economy. By using a resource-efficient model of economic development, it is possible to achieve sustainable development goals.

4 New Institutional Economics as a research perspective of the bioeconomy

In the bioeconomy area, the entrepreneurial perspective plays a key role in ensuring that social and economic expectations are met along with protecting nature. This perspective can be seen in accordance with the New Institutional Economics theory, which stresses out that institutions create the essential framework for the activities in the economic system, especially in terms of costs of the transactions occurring therein. The institutional environment of the enterprise provides a starting point for research for economists analyzing economic agents from the perspective of the New Institutional Economics (NIE) doctrine. NIE, in explaining economic phenomena, draws on the achievements of other disciplines. In its research method, it uses not only the principles of the traditional economic stream but also draws on the achievements of legal sciences, organizational theory, political science, sociology, psychology and anthropology (Hardt, 2005). NIE in its assumptions is based on the



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foundations of institutional economics created at the beginning of the 20th century by Thorstein Veblen. As Kowalska (2005) points out, the fundamental difference that separates the two approaches is the attitude towards theory: constructive in the case of NIEs, and critical among "old" institutionalists. In contrast to institutional economics, NIE creates its research agenda and actionable research methods.

NIE for learning about and explaining the economic processes taking place uses the concept of institutions, which are specific rules formed by society over centuries (Kuder, 2011). A complementary definition of institutions is that provided by Douglass North, who defined institutions as rules of human conduct that lead to the reduction of uncertainty and improve the degree of coordination of actions taken and economic relations established (Owczaruk, 2013). Within institutions, the subject literature distinguishes formal institutions, which are the rules of the game, top-down imposed by law in the form of constitutions, laws and regulations. In addition, it distinguishes informal institutions that are related to the cultural heritage of a country and developed moral norms, customs, or mores (Aoki, 2001). As Owczaruk (2013) points out, existing institutions must be characterized by completeness, complementarity, and substitutability.

4.1 Definition of transaction costs

Inextricably linked to NIE is the transaction cost theory. The originator of the concept is considered to be 1991 Nobel Prize winner Ronald Harry Coase, who originally defined transaction costs as the costs of using the price mechanism and market costs (Coase, 1937). On the other hand, another prominent economist and the creator of the concept of New Institutional Economics, Oliver Williamson, defined transaction costs as the comparative costs of planning, adapting and supervising the performance of tasks in different governance structures (Williamson, 1998). Although the concept of transaction costs has been well established in economic sciences, in scientific discourse they still do not have one widely accepted definition. Table 1 summarizes different definitions of transaction costs.



Table 1 Definitions of transaction costs

The scope of the definition	Author	Definition
Market mechanism	Coase (1937)	The costs of using the price mechanism
	Arrow (1969)	The cost of running the economic system
Property rights	Demsetz (1988)	The costs resulting from the transfer of property rights
Property rights	Allen (1991)	The cost appearing when property rights are transferred or they require protection
	Demsetz (1995)	The costs of coordinating resources through market arrangements
Operationalization of the transaction	Barzel (1977)	Involve all the required costs of coordinating and securing a contract
	North & Wallis (1986)	All costs associated with making exchanges, the costs of performing the transaction function
	Wang (2003)	The difference between the prices paid by the buyer and received by the seller

Source: Own construction according to the above cited references

As Gorynia and Mroczek (2013) point out, differences in the definition of transaction costs result from the differences in contracts related to the specifics of the given domestic and foreign sectors, and which entail different costs. Wieliczko (2010) argues that the transaction cost theory is an extremely important element of modern economic theory, playing a significant role in the development of this science. Danilowska (2007) notes that for NIE, transaction costs are the lens through which it explores key economic issues.



4.2 Factors influencing transaction costs and their role in the enterprise

Transactions are an unavoidable element of the functioning of any enterprise, and their specificity influences the resulting transaction costs. The literature suggests that each transaction can be described in terms of several dimensions or characteristics, including transaction frequency, the uncertainty of the transaction parties, opportunism, and asset specificity (Williamson 1998, Plichta 2009). As highlighted by researchers, the most important factor differentiating transactions is asset specificity (Slyk 2003, Mroczek 2014). Asset specificity is defined as the involvement of funds that are unique to a particular transaction. There are four types of asset specificity: location specificity, physical specificity, human asset specificity, and committed asset specificity (Szwedziak-Bork 2016). Another important dimension through which transactions are considered is opportunism, resulting from the tendency of transaction participants to put their own goals ahead of the goals of the transaction (Walczyk 2012). Each dimension affects the level of transaction costs that arise, as well as the possible methods of quantifying them.

The literature analysis shows that the level of transaction costs depends on three attributes: asset specificity, frequency of transactions and uncertainty of transaction participants (Marcinkowska 2017, Suska 2016, Hardt 2007). The level of transaction costs depends on many factors, including the information available, the complexity of the terms, and the ability to monitor the terms of each contract (Carlton 2020). Kraciuk (2015) points out that the costs incurred by a firm are due to the existing relationships between the firm's employees, as well as the firm's relationships with external stakeholders. Researchers also note that the transaction cost problem is an optimization problem where the level of each cost category is interdependent (Kállay et al. 2020, Puciato 2018), as higher ex-ante transaction costs are very likely to translate into lower ex-post transaction costs. Zygan (2014), in the context of the level of transaction costs in a company, emphasizes the importance of mutual trust both within internal relationships within the organization and relationships with external stakeholders. By increasing mutual trust, uncertainty is reduced, which reduces the level of transaction costs in the enterprise. Table 2 summarizes the factors that affect the level of transaction costs in the business.



Table 2 Factors affecting the level of transaction costs in an enterprise

Factors		Level of transaction costs	
Asset specificity	high	higher	↑
	low	lower	↓
Transaction frequency	high	lower	↓
	low	higher	↑
Uncertainty of transaction participants	high	higher	↑
	low	lower	↓
Opportunism of transaction participants	high	higher	↑
	low	lower	↓

Sources:

Williamson, O. (1998): Instytucje ekonomiczne kapitalizmu. Warszawa: Wydawnictwo Naukowe PWN.

Plich, J. (2019): Pomiar kosztów transakcyjnych – różne podejścia i perspektywa badawcza. *Ekonomista*, 3.

Walczyk A. (2012): Redukcja kosztów transakcyjnych przedsiębiorstw jako jedna z korzyści funkcjonowania w klastrach, *Ekonomiczne Problemy Usług*, 94, pp. 327-342.

Marcinkowska, E. (2017): Wpływ teorii kosztów transakcyjnych i teorii zasobowej na proces decyzyjny outsourcingu. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, 341.

Whereas Staniek (2010) expands the range of factors affecting the level of transaction costs. Indicates such determinants as the number of participants in a given transaction, the structure and nature of a given market, the type of contract, and the type and form of business ownership. The level of transaction costs in an enterprise affects the nature of decisions made by the organization, as well as the profitability of the business entity. Nikolaeva and Pletnev (2016) argue that firms that are unable to reduce their transaction costs risk becoming unprofitable. McCann et al (2005) indicate that transaction cost theory provides a way to understand the decisions that are made by economic actors in the bioeconomy. Milczarek-Andrzejewska (2012) distinguished the size of transaction costs of an enterprise as one of the most significant elements affecting the bargaining power of entities in the food chain, which is an element of the agricultural sector.

Monitoring the scale of a company's costs is critical to organizational effectiveness. Businesses operating in the bioeconomy incur certain transaction costs, and as Daniłowska (2007) points out, the desire to save transaction costs is the primary reason for the diversity of existing structures for managing broadly defined transactions. Walczyk (2012) notes that transaction costs are an important



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component of the overall cost of operating businesses in the market. From the perspective of company managers, knowledge of where certain costs arise is of fundamental importance. It allows not only the elimination or reorganization of cost-intensive processes but also translates into more efficient use of available resources. At the same time, as emphasized by Gorynia and Mroczek (2013), the ideas contained in the transaction cost theory have a key application in decisions related to the development of the company.

4.3 Typology of transaction costs

To accurately examine transaction costs, it is required to address the unique characteristics of the transaction and to categorize them on a per variables basis. The literature distinguishes several possibilities for the breakdown of transaction costs. Roszkowska (2019) points to such criteria for classifying transaction costs as the ability to quantify costs, the rationality of incurring costs, the phases of the transaction in which costs arise, and where costs arise. The first possible criterion for classifying transaction costs is that they can be quantified. Kowalska (2005) distinguishes measurable costs connected with accounting documentation concerning e.g. legal expertise for a given contract and non-measurable transaction costs connected with the time spent by employees on searching for contractors. When considering transaction costs from the perspective of the rationality of incurring them, it is pointed out that there are necessary transaction costs, which are necessary to carry out the transaction, and undesirable costs, which occur when the organization's resources are wasted (Roszkowska 2019). One of the most commonly used criteria in transaction cost analysis is that of the stage of the contracting process. This approach includes costs arising before the conclusion of the contract, i.e. ex ante transaction costs, as well as ex post costs related to the performance of the contract (Gruszecki 2002). The literature also indicates that transaction costs can be divided by the place of their origin, where public transaction costs, market transaction costs and managerial transaction costs are distinguished (Kyzenko O., Kyzenko D. 2016, Chotkowski 2010, Poniatowicz 2017). Considering transaction costs by their place of origin is also linked to the classical division of costs into fixed and variable costs (Wander 2014). On the other hand, Lazareva (2018) proposed a different approach to classifying transaction costs, among which she distinguished: transaction costs of entering the system, transaction costs of leaving the system, and transaction costs of hierarchy. Synthesizing the above approaches, it should be noted that they are complementary. Table 3 illustrates selected classifications of transaction costs.



Table 3 Selected classifications of transaction costs

Classification criteria	Types of transaction costs
Quantification capability	measurable
	unmeasurable
Rationality of incurring costs	essential
	undesirable
Contracting phase	ex ante
	ex post
Place where costs arise	market
	managerial
	public

Sources:

- Roszkowska M. (2019): Modele koordynacji lokalnych usług publicznych w kontekście ekonomii kosztów transakcyjnych. *Studia i Prace*, 1(37), pp. 43-76.
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- Gruszecki T. (2002): *Współczesne teorie przedsiębiorstwa*. Warszawa: Wydawnictwo Naukowe PWN.

4.4 Methods of measuring transaction costs

One of the main problems faced by transaction cost theory is its direct application in empirical research. As Collins and Fabozzi (1991) point out, researchers who want to measure the level of transaction costs in a company will have to deal with three distinct problems related to the specificity of a company's assets, defining a benchmark for measuring venture and opportunity costs, and isolating the factors that affect the level of transaction costs. Regarding the problems that scholars face when it comes to measuring transaction costs, Serigati and de Azevedo (2016) note aspects such as the lack of adequate data, the inability to observe many of the relevant characteristics of the transactions that take place, and the lack of a uniform definition of transaction costs.

Economists, despite the difficulty of empirically applying transaction cost theory, have attempted to estimate transaction costs in both macroeconomic terms of the level of transaction costs in the economy and microeconomic terms. In the context of measuring transaction costs in an enterprise, the two most commonly used



approaches to measuring transaction costs are indicated (Chlebicka, Strzębicki 2009, Plichá 2019). In a direct approach, the measurement of transaction costs is based on the traditional analysis of a firm's costs, which are incurred in the various stages of a transaction. In contrast, the second approach - indirect - looks for relationships between transaction costs and the factors that influence their formation and amount. In such a view, the analysis should primarily focus on factors related to the characteristics of the transactions themselves. The lack of uniform treatment in the literature of the issue of measuring transaction costs translates into many possible research methods. Lu et al (2012) identified four possible methods for measuring transaction costs from the perspective of a business entity, among which they distinguished: the margin method, the typical reference quantity method, the investigation method, and the data statistics method. Table 4 shows the advantages and disadvantages of the indicated methods for measuring transaction costs.

Table 4 Advantages and disadvantages of transaction cost measurement methods

Method	Used in the research	Advantages	Disadvantages
margin method	Stavins (1995)	To assist the company in selecting the operating pattern that generates the most profit.	Doesn't include all transaction costs.
typical reference quantity method	Dyer & Chu (2003)	Useful for conducting comparative transaction research.	It is too difficult to analyze the total transaction costs.
investigation method	Bakare & Gold (2011)	A practical method to illustrate the effect of factors on transaction costs.	It is possible to exclude significant factors affecting cost levels.
data statistics method	Falconer & Saunders (2002)	A method that takes many factors into account.	Considerable labor and time resources are required to conduct the research.

Source: Own construction according to the above cited references



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4.5 Transaction costs in the bioeconomy – the review of empirical research

A review of the literature found that past research by economists has not addressed the issue of measuring transaction costs in bioeconomy companies. A study by Wen and Chatalova (2021) showed the impact of transaction costs and economies of scale on the area of agricultural biomass production in Germany by creating an econometric model. In the study cited above, the authors didn't consider all possible variables, such as biomass and land prices, environmental variability, and the aspect of competition within the sector, which could also have a significant impact on the results obtained. Results from Wen and Chatalova (2021) showed that a higher degree of asset specificity increases transaction costs while reducing the rate of farm downsizing. Altman and team's (2007) research work examined the relationship between transaction costs and economies of scale and the impact of these factors on bioenergy production in the United States. The study used survey data from 53 companies creating bioenergy. The authors of the publication point to the connection between the aspect of transaction costs incurred by business entities and the obtained economies of scale of production. Altman and team (2007) indicate that these aspects are key compromises in organizational decision making. Economists have also conducted research focusing on measuring transaction costs in the agricultural sector (Deng, Zhang 2020, Traversac et al. 2011, Drygas 2011, Wander et al. 2003, Key et al. 2000), as well as the impact of agrarian (Rørstad et al., 2007) and environmental policies (Pannell et al. 2013, Mettepenningen et al. 2009, Huusom, Strange 2008, Falconer, Saunders 2002) on the level of transaction costs of enterprises. Deng and Zhang (2020) used a diagnostic survey of employees and business owners to show the impact of transparency of the transaction process on the level of transaction costs. The lack of openness and honesty between counterparties has been proven to foster high transaction costs. Whereas Drygas (2011) in his study focused on the aspect of public transaction costs. Using data from publicly available reports on the activities of the Agency for Restructuring and Modernization of Agriculture (ARiMR), the author of the study estimated the size of the public transaction costs incurred. Drygas (2011) also pointed out the factors affecting the level of transaction costs, among which he distinguished, in particular, the complexity and vastness of the institutional system, as well as the excessive bureaucratization of procedures. Difficulties in communication between transaction participants also significantly affect the level of public transaction costs. At the core of the bioeconomy, in addition to the agriculture sector, there is also, the forestry and fisheries sector. Within these two sectors and related fields, there has also been research work focusing on the measurement of transaction costs and their impact on business performance (Womble, Hanemann 2020, Nantongo, Vatn 2019, Niquidet, O'Kelly 2010). Womble and Hanemann's (2020) study focused on determining the impact of regulatory changes in Colorado (USA) water market on transaction costs. Using a survey questionnaire, the researchers determined which of the possible



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modifications of the law have the most beneficial effect on lowering transaction costs. The cited studies were characterized by an indirect approach that specifically examined the impact of individual factors on transaction costs. The transaction cost analysis primarily used an investigative method based on the creation of an econometric model. Transaction cost measurement results obtained by the researchers in bioeconomy sectors are summarized in Appendix 1. As Man et al. (2017) point out, transaction costs, despite their difficulty in measurement, should be estimated and evaluated because they are important elements in the decision-making process. the authors of the cited publications indicate the need for deeper research in the field of transaction costs.

5 Conclusion

The reorientation of the current perception of the impact of human activity on the environment and the focus on the use of renewable resources creates strategic growth opportunities for companies, not only in the bioeconomy sector. Within the bioeconomy, the right rules of the market game are important, creating an important institutional background. In bioeconomy businesses, transaction costs affect not only their profitability and decision-making but also their competitiveness. The conducted literature review showed that there are many opportunities to study the level of transaction costs in bioeconomy enterprises. It should also be emphasized that in the case of research aimed at determining the level of transaction costs, special attention needs to be paid both to specific institutional conditions and the dimensions and attributes of individual transactions.

It is argued that to examine the level of transaction costs in bioeconomy companies, the following criteria should be used as a starting point: specification of the assets involved in the transactions, determination of the frequency of transactions, determination of the level of uncertainty in the company, determination of the significance of the opportunism factor in the participants of the transactions. Based on the underlying assumptions, attempt to develop a typology of transaction costs in the bioeconomy. Based on the presented methods of measuring transaction costs, as well as empirical studies conducted so far, the author suggests that an indirect approach focusing on the analysis of factors shaping the level of transaction costs should be used. Using the investigative method, the need for an econometric model is indicated to determine the impact of variables on a company's transaction costs. The amount of transaction costs determine the decisions made in the organization and translates into the way bioeconomy enterprises function. Knowing the factors and how they affect the different agents will enable the optimization of transaction processes and consequently reduce the level of transaction costs in bioeconomy enterprises.



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Appendix 1. Results of measuring transaction costs in bioeconomy sectors

Area	Author(s)	Methods	What aspect was studied	Results
Biomass production	Wen & Chatalova (2021)	Based on data from 2005 to 2016 from the European Statistical Office (Eurostat), the Federal Ministry of Food and Agriculture, and the German Land Market Report, the base parameters of the model were determined. Data environment analysis (DEA) was used.	Based on the example of Germany, the influence of economies of scale and transaction costs on the area of agricultural biomass production in Germany was investigated.	A higher degree of asset specificity is shown to increase transaction costs while reducing the rate of farm downsizing.
Bioenergy production	Altman & team (2007)	The study used survey data from 53 bioenergy creation companies.	The relationship between transaction costs and economies of scale was verified and their impact on bioenergy production in the United States.	It was pointed out that there is a link between transaction costs and the economies of scale of production obtained.



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Area	Author(s)	Methods	What aspect was studied	Results
Rural cooperative land market	Deng & Zhang (2020)	A diagnostic survey was conducted where 350 responses were obtained from employees and managers. The Tobit model was used.	The effect of transparency of the transaction process on the level of transaction costs was studied.	The lack of openness and honesty between counterparties has been shown to foster high transaction costs.
Wine producers	Traversac & team (2011)	The study sample was a collection of Farm Census wine producers. A logistic regression model was used.	The link between wine producer size and direct wine sales was verified using transaction cost economics.	Transaction cost savings were found for large wine farms.
EU support for rural areas	Drygas (2011)	The data from the reports on the activities of the Agency for Restructuring and Modernisation of Agriculture (ARiMR) were used.	The amount of public transaction costs incurred by the Agency for the Restructuring and Modernization of Agriculture was quantified.	The level of public transaction costs incurred by the Agency for Restructuring and Modernisation of Agriculture was estimated. The factors affecting the level of public transaction costs were identified.



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Area	Author(s)	Methods	What aspect was studied	Results
Agrarian policy	Rørstad & team (2007)	Interviews were conducted with agricultural market participants for each agrarian policy measure.	The effect of agrarian policy in Norway in particular areas on the level of transaction costs was studied.	It has been shown that differences in transaction costs incurred by farmers are mainly due to differences in asset specificity and the nature of the agrarian policy measure in question.
Water market	Womble & Hanemann (2020)	A diagnostic survey was conducted among 100 legal and hydrological experts. A logistic regression model was used.	The impact of introduced legal changes in the water market in the state of Colorado (USA) on the amount of transaction costs was verified.	It was determined which of the possible modifications to the law is most beneficial in reducing transaction costs.
Forestry	Niquidet & O'Kelly (2010)	The study used survey data from 136 companies - sawmills located in Sweden and New Zealand. A fractional logit model (FLOGIT) was used.	The study examined whether transaction costs affect the decision of forestry firms in terms of contractor selection and contract length.	Firm constraints such as capital were found to negatively affect transaction costs. It was concluded that the choice of contractor and the length of the contract



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Area	Author(s)	Methods	What aspect was studied	Results
				depends largely on the characteristics of the supplies, which vary by region as well as by type of processing plant.