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Modeling a Financial Controlling System for Managing Transfer Pricing Operations

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Abstract

The management of transfer pricing operations is considered from the perspective of modeling financial and accounting processes for various organizations, using agricultural enterprises as an example. It is demonstrated that the execution of transfer pricing operations between related parties—which may function as responsibility centers within an organizational holding structure—serves as a managerial lever influencing the financial income and expenses of individual business units. It is revealed that the developed model of managerial accounting for transfer pricing operations, grounded in tax compliance and the balancing of stakeholder interests, is based on two key aspects: first, to ensure the balanced development of the company's business units, a list of key performance indicators (KPIs) is developed and integrated into a balanced scorecard (BSC), promoting the sustainable and stable operation and growth of the company; second, with access to this list of KPIs, the manager of each business unit can exert indirect influence over a segment of the final product's value chain by selecting transfer prices that adhere to the arm's length principle. The practical application of the proposed model is illustrated using previously formed economic operations from the research base.

Keywords: accounting; finance; transfer pricing operations; controlled transactions; financial controlling; financial management; financial flow management

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1. Introduction

The management of transfer pricing operations is a complex and burdensome process for companies, as the accuracy of conducting, documenting, and formalizing such operations determines both the performance outcomes and the results of tax authority audits,

ultimately shaping the business entity's "tax reputation." Indeed, the management of such operations begins with their documentation, recording in the accounting system, execution, analysis, and control [1–3].

Therefore, for the well-founded application of a transfer pricing method that adheres to the arm's length principle, companies require effective and robust informational support for this process, which, under modern conditions, should be developed within the environment of management information systems using automation and digitalization tools [4–6].

The purpose of this article is to conceptualize the structure and content of informational support for the management of transfer pricing operations and to break down the accounting, analytical, and financial control components in order to account for all factors that may influence the financial management process.

The research hypothesis posits that the integration of the tax compliance principle with the balanced scorecard (BSC) system within the managerial accounting information system enables improved efficiency in managing transfer prices between the structural subdivisions of a holding company. The novelty is justified by the absence of integrated models that formally combine the KPI approach with enforcement of the arm's length principle in intra-group transactions.

The remainder of this paper is structured as follows. Section 2 provides an overview of existing research on transfer pricing systems, risk assessment, and financial management, including in the agricultural context. Section 3 describes the methodology used to model the financial controlling system. Section 4 presents the results of the application of the model. Section 5 presents the conclusions, limitations of the model, and directions for future research.

2. Literature Review

Transfer pricing management is a critical and complex area of corporate finance and international taxation globally, increasingly recognized as a central lever of strategic financial control in multinational enterprises [5]. Research on transfer pricing has evolved globally, examining its role in profit allocation, tax compliance, and performance management across industries and economic systems.

The investigation of the transfer pricing system, as well as the principles of its development, enhancement, and practical implementation in Ukraine, falls within the scope of scientific interest of domestic researchers such as Grigoroi, Grosu, Kulynych, Melega, Morhunenko, Storozhuk, and others [4,7,8].

The method of investigation proposed in [4] involves the establishment of methodological approaches to determine transfer prices as a tool for business management within the management system, highlighting both advantages and disadvantages. The author suggests developing the pricing structure based on return-on-investment (ROI) indicators.

The authors of the study [7] developed a financial and accounting model for transfer pricing, grounded in standardized accounting policies. Their model was based on an analysis of the tax and accounting frameworks of 163 countries representing various economic and political groups. The study substantiates that the chosen transfer pricing method depends on the economic power of affiliated entities within a given country. Furthermore, the dynamics of fiscal health are directly proportional to the overall development of economic security and the economic growth rate of the respective group. In [8], a two-tier model of accounting policy for transfer pricing in transnational corporate groups is proposed. It consists of the parent company level and the level of other entities within the group. This division reflects a decentralized approach to determining the accounting policy elements of an international group, considering the specific operational features of all group members.

In particular, the risks associated with transfer pricing systems are actively studied, with notable contributions from scholars such as Bohdan, Kucherenko, Lekar, Ryzhenkova, Shevchuk, and Tytenko [9–12]. In [9], the authors proposed a conceptual model of transfer pricing as a tool for assessing the management capacity of subsidiaries, using satisfaction with performance criteria of structural units at the headquarters as a benchmark. The study identifies three types of transfer prices—market-based, cost-based, and negotiated—along with their various modifications applicable to enterprises operating in competitive markets. These apply to the transfer of goods, labor, and services within a corporate group. In [10], the authors developed a risk assessment matrix by combining indicators of potential tax losses with the probability of their occurrence. This approach enables a comprehensive evaluation of the overall risk level, provides insights into the potential impact on an entity's operations, and supports decision-making regarding risk mitigation strategies.

The authors of study [11] conducted an analysis of regulatory legal acts and identified the most significant measures of administrative and legal regulation in the financial and tax spheres of Ukraine under the legal regime of martial law. The key measures include resource mobilization, allocation of budget funds for military and humanitarian needs, attraction of external resources, regulation of foreign exchange transactions and pricing, financial and resource control, resource conservation, and the use of reserves and special funds.

The author of study [12] examined the importance of transfer pricing and outlined the procedure for establishing transfer prices, ultimately evaluating alternative transfer pricing methods.

Research in the field of financial operations management, particularly as applied to various areas of agricultural production, has been conducted by scientists from different countries. The article by Fahlevi et al. [13] explores the roles of financial awareness (FA) and financial capability (FC), as well as their influence on risky financial behaviors—specifically, risky payment behavior (RPB), risky borrowing behavior (RBB), and the achievement of financial goals (FG)—among agro-based SMEs in East Java. The study highlights the urgent need to implement financial literacy programs to help SME owners manage irregular cash flows and reduce risky financial behaviors. The authors recommend that financial institutions develop accessible financial instruments and products tailored to the needs of agro-based SMEs.

In the paper by Zhang et al. [14], a method for integrating real-time data elements into financing models is presented, addressing the critical issue of information asymmetry between financial institutions and retail SMEs in China. By utilizing dynamic data—such as orders, accounts receivable, and project progress—the authors developed a framework that leverages advanced data analytics to enhance credit assessment and risk management.

In the study by Geng et al. [15], a production cost function model is employed to measure the cost elasticity of farmland scale management and to examine whether such management practices can achieve economies of scale in real-world agricultural production. In the study by Poppe et al. [16], an interface for sustainability reporting was developed through the integration of information flows from farm systems, farm financial accounting, and management information systems. Data on resource use and production could be added using procedures similar to those in current FMISs, but with reduced data entry, lower risk of discrepancies, and the ability to cross-check results.

The study by Źróbek-Różańska [17] is based on the net present value (NPV) criterion, a method widely used to assess the effectiveness of investments in the real estate market, and it is applied to forest plantations in Poland. The financial feasibility analysis, conducted using this method with forest plantation statistics and a 5% discount rate on the Polish forest market, revealed the highest increase in net cumulative cash flows during the first five years, followed by a gradual decline in subsequent years.

The literature on the topic of our article shows the integration of sustainable solutions into agricultural management and reporting, which is crucial for assessing the holistic performance and long-term viability of agricultural holdings. Pedolin et al. [18] assess the environmental performance of Swiss agriculture using life cycle assessment. Zaruk et al. [19] propose a concept for optimizing the location of crop production to minimize environmental impacts.

Witt et al. [20] analyze the implications of the European Corporate Sustainability Reporting Directive (CSRD) for farmers, highlighting the growing need for detailed ESG (environmental, social, and governance) reporting. Complementing this, Anguiano-Santos and Salazar-Ordóñez [21] consider sustainability reporting as a tool to promote sustainable growth in the agri-food sector. Together, these works highlight the need to integrate non-financial (ESG) key performance indicators into financial control systems, which can be influenced by transfer pricing decisions and are vital for balanced corporate development. Krachunova et al. [22] show the application of digital technologies available for nature conservation and the provision of ecosystem services in agriculture. Technological capabilities can support data collection and performance monitoring for an integrated financial control system.

Despite extensive research in transfer pricing and financial operations management within agriculture, there remains a gap in the development of comprehensive financial controlling models that integrate key performance indicators (KPIs) and a balanced scorecard (BSC) for strategic transfer pricing management within agricultural holdings while simultaneously considering tax compliance principles and balancing stakeholder interests. Our article bridges this gap by proposing precisely such a model, demonstrating its practical application using agricultural enterprises as an example.

It is deemed appropriate to structure the approach to systematizing the methodological toolkit of a risk-oriented approach within the tax control system for transfer pricing.

3. Materials and Methods

The methodological basis for studying the research object was grounded in the principles of systems analysis theory, particularly through the implementation of a comprehensive and integrated approach to problem decomposition. The following methods were employed during the research:

- general scientific methods—analysis and synthesis, induction and deduction, concretization, formalization, abstraction, modeling, and analogy (applied in the process of formulating research questions);
- component analysis—used to identify the characteristic features of transfer pricing control systems and to develop a quality metrics system for the company's transfer pricing policy and internal control system;
- optimization—employed in developing a managerial accounting model for transfer pricing operations based on tax compliance and the alignment of stakeholder interests;
- computer programming—applied in the development of automation schemes for preparing transfer pricing documentation and the company's tax profile (presented as a dashboard) within the transfer pricing tax control system.

All mathematical models were implemented using MS Excel 2016 with VBA macros, Python 3.11.5 (libraries: pandas 2.2.2, numpy 1.26.4, scipy 1.13.0, matplotlib 3.8.4), Power BI Desktop (March 2024 version), and the MS SQL Server 2019 database. Part of the code is available upon request; the model structure and formulas allow for full reproducibility of the results by other researchers.

4. Results

Research on the financial accounting system and accounting technologies in transfer pricing indicates a clearly defined conceptualization of the information function of accounting in the management of transfer pricing operations [10,11]. If the financial accounting system is capable of providing information of interest to external stakeholders, then alongside it, the management accounting system should function properly as informational support for decision-making by internal stakeholders [23,24].

In the context of managing transfer pricing operations, the management accounting system is responsible for fulfilling two primary functions:

- firstly, serving as a tool for informational support in decision-making;
- secondly, acting as a mechanism for post-decision control [9,12,23,25,26].

The first function is implemented through the collection, processing, and utilization of detailed (including planned) information to support the management decision-making process. The second function involves the use of factual and detailed data to assess the effectiveness of the decisions made regarding transfer pricing [23,27–30].

The implementation of transfer pricing operations between related parties, which may function as responsibility centers within an organizational holding structure, serves as a managerial tool influencing the income and expenses of individual business units. The key instrument of such managerial influence is the transfer price itself [8,27]. We propose a model for managing transfer pricing operations that is grounded in the principles of tax compliance and aims to balance the interests of all stakeholders (Figure 1). The model presented in Figure 1 is based on three key approaches: the responsibility center concept, the arm's length principle (OECD Transfer Pricing Guidelines), and the balanced scorecard (BSC) methodology. This framework formalizes the relationship between pricing and the performance of business units within the context of tax compliance.

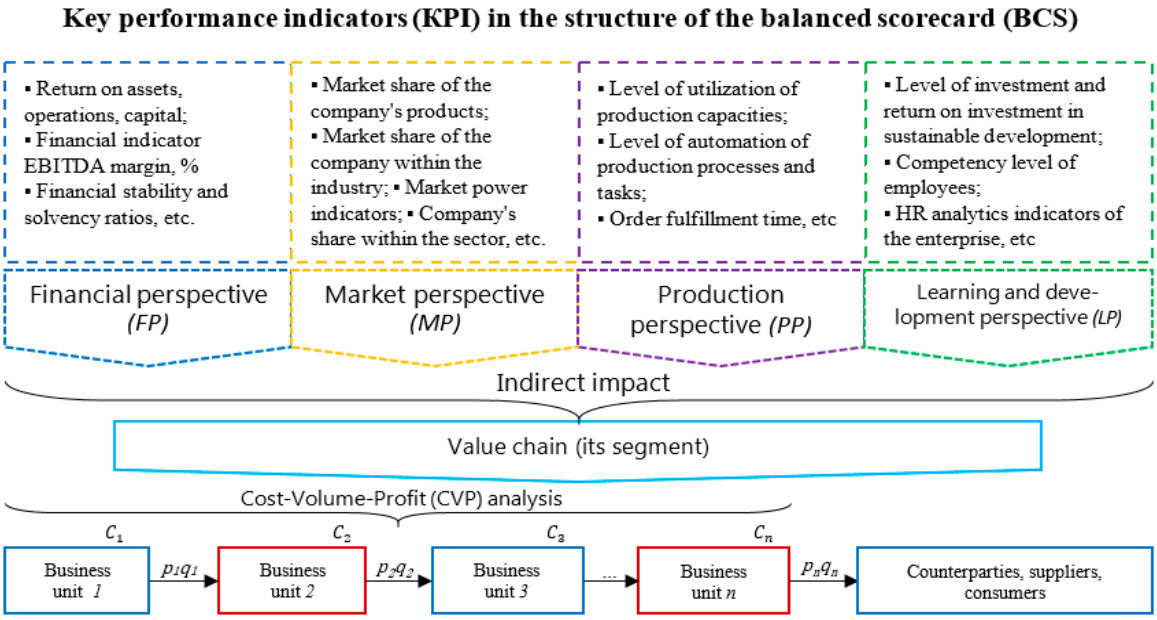


Figure 1. Model of managerial accounting for transfer pricing operations based on tax compliance principles and stakeholder interest balancing: C_1, C_2, C_3…, C_n—Costs of production and sales; q_1, q_2, q_3…—Volumes of resources for internal production; q_n—Volume of product sales; p_1, p_2, p_3…—Transfer prices in accordance with the arm's length principle; p_n—Selling price of the product.

The constructed model of managerial accounting for transfer pricing operations based on tax compliance principles and stakeholder interest balancing is grounded on two main aspects:

For the balanced development of company business units, a list of key performance indicators (KPIs) is developed and integrated into a balanced scorecard (BSC) system, which contributes to the sustainable and stable functioning and development of the company.

Having obtained such a list of KPIs, the manager of each individual business unit exerts indirect influence on the value creation chain segment of the final product through the selection of a transfer price that adheres to the arm's length principle.

The mentioned aspects represent the two main pillars of the developed model—adherence to tax compliance principles and balancing stakeholder interests. However, the complexity of combining these two aspects requires the development and implementation of automated optimization models that take into account all constraints defined by KPIs and the ultimate goals of business units' activities and the company as a whole. Let us demonstrate the practical application of the proposed model on previously formed business operations from the research database.

To demonstrate the practical application of the proposed model, we turn to previously recorded business operations from the research database. Specifically, we will examine a segment of the value creation chain from an agro-industrial and trading company in terms of how business unit results are formed based on the profit and loss (P&L) report [8,23,24]. The schematic representation of the value creation chain segments is shown in Figure 2.

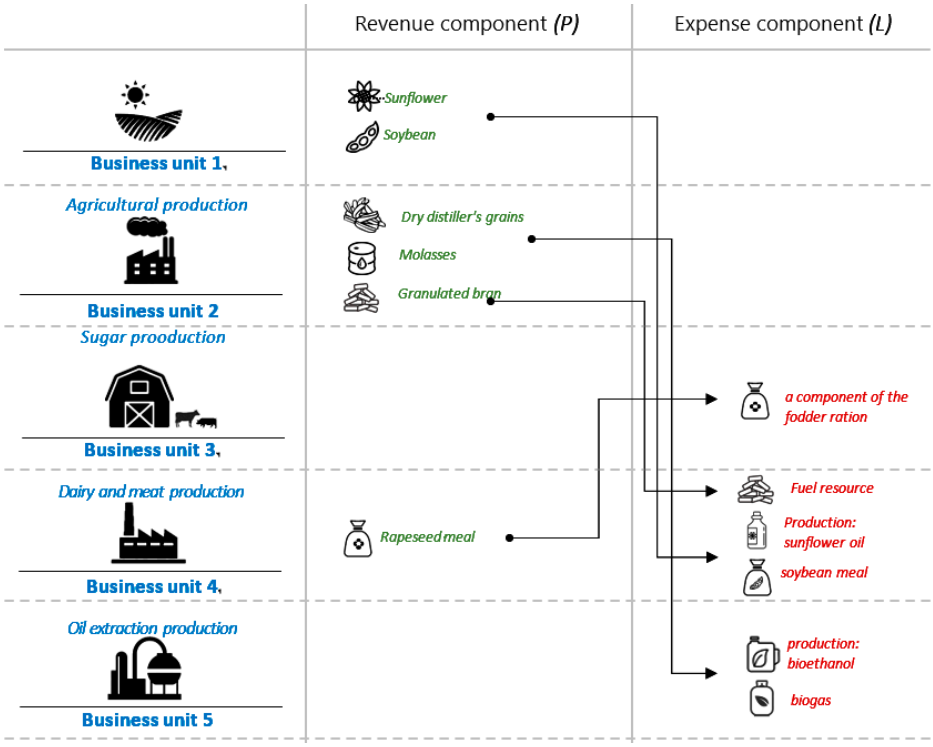


Figure 2. Model of the value creation chain segments in the transfer pricing system.

In each of the five case studies, analysis is conducted from a dual perspective: firstly, assessing the conformity of the transfer price with the arm's length principle and, secondly, evaluating the impact of this price on the key financial indicators of the respective business unit. This approach allows for an empirical assessment of both tax compliance and operational efficiency simultaneously.

The model of the value creation chain segments in the transfer pricing system can be explained by segmenting it as follows:

1. Business Unit 1 "agricultural production": by selling sunflower seeds and soybeans at a specified transfer price, Business Unit 1 generates revenue. In turn, Business Unit 4 incurs raw material expenses (which are included in the cost of goods sold) when purchasing these sunflower seeds and soybeans to produce sunflower oil and soybean meals.
2. Business Unit 2 "sugar production":
    - 2.1 By selling molasses and dry distiller's grains at a defined transfer price, Business Unit 2 earns revenue. Business Unit 5 incurs raw material and energy costs (also included in the cost of goods sold) when purchasing these products to produce bioethanol and biogas.
    - 2.2 By selling granulated distiller's grains at a specific transfer price, Business Unit 2 earns additional revenue. Business Unit 4 incurs energy-related expenses (reflected in the cost of goods sold) when purchasing these granulated distiller's grains for use in the production of sunflower oil and soybean meal.
3. Business Unit 4 "oil extraction production": by selling rapeseed meals, Business Unit 4 earns revenue. Business Unit 3 then incurs feed-related costs (accounted for in the cost of goods sold) when purchasing this rapeseed meal for use in livestock farming [24].

By utilizing transfer pricing as a tool for setting prices in intra-group transactions, companies— as previously noted—can influence the financial outcomes of their business units (i.e., responsibility centers). This approach has long been employed as a means of optimizing the tax base, particularly prior to the introduction of regulatory controls ensuring adherence to the arm's length principle. Tax optimization models based on transfer pricing operations have been widely explored by numerous scholars. However, with the goal of shifting the philosophy of transfer pricing toward a compliance-oriented tool that balances the interests of stakeholders, we find it appropriate to propose our own optimization model. As a preliminary step, it is essential to classify and codify revenue and expense items within the company's management accounting system [31–33].

Assuming that within the holding company, one business unit transfers raw materials to another business unit in the amount of Q_{ij} (where i, j is the corresponding segment code, the type of raw material) to produce the main type of product. Depending on the level of the established transfer price, the holding company will receive income (for the selling business unit) and incur expenses (for the purchasing business unit). From the perspective of management accounting, the sale of raw materials at a price p_{ij}, which is lower than the transfer price tp_{ij} $\left(p_{ij} < tp_{ij}\right)$, reduces the potential revenue for the selling business unit, thereby decreasing its financial result. For the purchasing business unit, this scenario provides conditions for reducing the cost of the main product, thus potentially increasing its financial result. Within the holding, these operations mutually exclude each other (the overall change in pre-tax financial result equals 0). However, under different tax regimes in which business units operate, this serves as a vivid example of non-compliance with tax legislation in the field of transfer pricing. Therefore, we consider it appropriate to introduce additional constraints on compliance with established prices within transfer pricing operations (or price range) when constructing performance optimization models for responsibility centers, adhering to the principle of arm's length and conditions for the balanced development of company business units. The implementation of this integrates into the system of management accounting methods and tools the principles of managing transfer pricing operations based on tax compliance and stakeholder interest balancing. The

stakeholder approach here is manifested not only through compliance with tax authority requirements but also through ensuring sustainable and balanced development of business units within the holding structure.

Using the example of a business operation in which one business unit sells sunflower seeds to another to produce sunflower oil, we can examine the algorithm for constructing optimization models aimed at managing the performance of business units within a holding company. The business unit selling the sunflower seeds seeks to maximize its revenue (R_{A_3}):

$$A_{i_3} = \{R_{A_3} = q_{A_3} \cdot p_{A_3} \rightarrow max \tag{1}$$

where A_{i_3} is the operation of the agricultural production segment, q_{A_3} is the volume of sales; and p_{A_3} is the selling price.

In turn, the business unit purchasing sunflower seeds for the production of sunflower oil includes the expenses incurred in its purchase as variable costs in the production cost (C_{O_1}), with the aim of reducing the production cost:

$$O_i = \begin{cases} C_{O_1} = \left(cv_{O_1} + cf_{O_1} + cs_{O_1} + ch_{O_1}\right)/vp_{O_1} \rightarrow min \\ cf_{O_1}, cs_{O_1}, ch_{O_1}, vp_{O_1} = const \\ cv_{O_1} = cv_{pl_{O_1}} + cv_{eO_1} + cv_{rdO_1} \\ cv_{pl_{O_1}}, cv_{eO_1} = const \\ cv_{rdO_1} = q_{A_3} \cdot p_{A_3} + cv_{rd(oth)_{O_1}} \end{cases} \tag{2}$$

where O_i is the operation of the oil extraction production segment; cv_{O_1}, cf_{O_1}, cs_{O_1}, ch_{O_1} are variable, fixed, marketing, and holding costs, respectively; vp_{O_1} is the volume of production; and $cv_{pl_{O_1}}$, cv_{eO_1}, cv_{rdO_1} are articles of variable costs (labor costs, energy resources, and raw materials).

However, such an operation can be carried out at a price within the range of prices that adhere to the arm's length principle (TP_i):

$$TP_i = \left\{tp_{min\,A_3} \leq p_{A_3} \leq tp_{max\,A_3}\right. \tag{3}$$

where $tp_{min\,A_3}$ and $tp_{max\,A_3}$ are the lower and upper bounds of the transfer price range that adhere to the arm's length principle, respectively.

The previously defined and formed list of KPIs for the company's business unit will constitute a balanced scorecard for the business unit (KPI_A):

$$KPI_A = \begin{cases} KPI_{FP_A} = \left\{KPI_{1_{FP_A}}, KPI_{2_{FP_A}} \ldots, KPI_{n_{FP_A}}\right\} \\ KPI_{MP_A} = \left\{KPI_{1_{MP_A}}, KPI_{2_{MP_A}} \ldots, KPI_{n_{MP_A}}\right\} \\ KPI_{PP_A} = \left\{KPI_{1_{PP_A}}, KPI_{2_{PP_A}} \ldots, KPI_{n_{PP_A}}\right\} \\ KPI_{LP_A} = \left\{KPI_{1_{LP_A}}, KPI_{2_{LP_A}} \ldots, KPI_{n_{LP_A}}\right\} \end{cases} \tag{4}$$

where KPI_A is the balanced system of key performance indicators for the agricultural production segment and KPI_{FP_A}, KPI_{MP_A}, KPI_{PP_A}, KPI_{LP_A} are key performance indicators for financial, market, production, and learning and development perspectives, respectively.

Taking into account the need to ensure sustainable and balanced development of business units within the holding structure, the key performance indicators indirectly related to the business operation of selling sunflower seeds to produce sunflower oil by another business unit will shape the following conditions for the intersection of the

management accounting model for determining volumes, revenues, expenses, and the balanced scorecard:

$$A_i \cup O_i = \begin{cases} A_i \cup KPI_A \cup TP_i \\ O_i \cup KPI_O \cup TP_i \end{cases} \quad (5)$$

The latter is a generalized mathematical expression of the functioning of the management accounting model for transfer pricing operations based on tax compliance and stakeholder balancing. It should be noted that the implementation and achievement of optimization modeling goals are possible through the tools of the operations management information system for transfer pricing operations [34].

The results of applying the management accounting model for transfer pricing operations based on tax compliance and stakeholder balancing for the operation, using the example of the sale of sunflower seeds for the production of sunflower oil by the business units of the holding company, are depicted in Figure 3.

Optimization model in transfer pricing management

The operation of selling sunflower by a business unit for sunflower oil production

Block 1. Key Performance Indicators (KPIs) related to the operation/segment

	segment A **«Agricultural production»**		***segment O*** **«Oil Extraction production»**	
	KPI`s	***value***	***KPI`s***	***value***
Financial perspective (FP)	ebitda margin, %	9.1%	ebitda margin, %	9.1%
Market perspective (MP)	x	x	x	x
Production perspective (PP)	x	x	x	x
Learning and Development Perspective (LP)	x	x	x	x

Block 2. Range of transfer price for the operation object

The transfer price for sunflower, which corresponds to the arm's length principle, is in the range of:

from 370 $/t to 400 $/t

Block 3. Range of transfer price for the operation object

Input parameters		
Quantitative scope of the operation	10,000	tons
Output of finished products	40	%
Production volume	4000	tons

Estimated parameters		
Costs of sunflower cultivation	350	$/t of raw materials
Costs of production (excluding raw material costs)	254	$/t of finished products
Raw material costs (depending on the established transfer price)	963	$/t of finished products
Sale price of finished product	1338	$/t of finished products

Optimization conditions:	
Income from sunflower sales	max
Costs of sunflower oil production	min
KPI system BCS	v
Compliance with the arm's length principle	v

Modeling result

optimal transfer price for the transfer pricing operation object: 385 $/t

Figure 3. Results of optimization modeling in managing transfer pricing operations based on tax compliance and stakeholder balancing.

The information used to construct the presented model is derived from the management accounting system, which functions as a separate module within the broader corporate information system—specifically from the Balanced Scorecard directory and the Cost of Production report. To determine the acceptable range of transfer prices in

accordance with the arm's length principle, we propose the development of a dedicated functional tool within the transfer pricing operations management information system. This tool will be described in more detail below.

Overall, the presented model for the operation subject to control criteria is based on the principle of ensuring equal EBITDA margin (%) indicators across the holding company's segments while also ensuring that the established transfer price complies with the arm's length principle. Accordingly, based on the results of modeling—considering constraints, input parameters, and conditions—the transfer price for the transaction in question was determined [23,28,32,34].

To establish informational support aligned with the arm's length principle in transfer pricing, it is essential to systematize the approach to developing and modeling accounting support within the management accounting system for transfer pricing operations.

In our view, modeling accounting support within the management accounting system serves as a tool for providing information necessary for decision-making related to transfer pricing, as well as for conducting post-implementation evaluations of decision effectiveness [23].

The outcome of this modeling process should be a management model developed within the framework of the transfer pricing operations management information system (specifically, the Analysis and Analytics module) and validated through practical cases within the company [23]. At the core of this model is a unified approach to establishing transfer prices and verifying their compliance with the arm's length principle, in accordance with individually applicable methods [32,34–36].

The information for building the displayed model is sourced from the management accounting system, which is a separate functional module within the structure of the corporate information system (specifically, the Balanced Scorecard directory and the Cost of Production report). To determine the range of transfer prices that adhere to the arm's length principle, we propose developing a separate functional tool within the structure of the transfer pricing operations management information system, which will be described in more detail below. Overall, the demonstrated model for the operation subject to controlled criteria is built on the condition of equality of the EBITDA margin (%) indicators across segments of the holding company and compliance of the defined transfer price with the arm's length principle. Accordingly, based on modeling results considering constraints, input parameters, and conditions, the transfer price for the operation object was determined [23,32,34].

To establish informational support in line with the arm's length principle for transfer pricing, it is necessary to systematize the approach to developing and modeling accounting support within the management accounting system for transfer pricing operations.

In our view, modeling accounting support within the management accounting system serves as a tool for providing informational support for decision-making related to transfer pricing, as well as for conducting post-control evaluations of their effectiveness [23].

The result of this modeling process should be a management model developed within the framework of the information system for managing transfer pricing operations (specifically, the Analysis and Analytics module) and validated through practical application within the company [23]. At the core of this model lies adherence to a unified approach for establishing transfer prices and verifying their compliance with the arm's length principle, using individually applicable methods [32,34,36].

To demonstrate the practical implementation of this decision-making scheme around methodological support for managing transfer pricing operations, we will use the example of business operations from an agro-industrial and trading company previously discussed in the theoretical and methodological section of this dissertation.

4.1. Business Operation 1

A business unit engaged in agricultural activities (Ukraine) supplies raw materials—sunflower and soybean seeds—to business units involved in oil extraction operations (Poland). The finished products—sunflower oil and soybean meal—are subsequently sold through a trading house located in Poland.

One of the components of this business operation that qualifies as a "controlled transaction" is the sale of soybeans (a raw commodity). It is important to note that for such transactions, the application of the comparable uncontrolled price (CUP) method is mandatory to ensure compliance with the arm's length principle. The management model for determining the transfer price, along with its verification using the CUP method, is presented in Figure 4.

Determining the transfer price within the controlled transaction operation
considering its compliance with the "arm's length" principle

1	***The method used to assess compliance with the "arm's length" principle:***												comparative uncontrolled price				
2	***The object of the operation***												soybeans, whether or not crushed				
3	***Volume of operation, tone***												9800				
4	***Comparison base*** *(select the necessary)*						✓	SWOT	✓	Euronext		WCE					
							✓	BCA		NYBOT		LIFFE					

Calculation of the range of transfer prices for the operation object

Prices on stock exchanges				*Prices according to growth*		№		
1	SWOT	500.7	$/t	NYBOT	497.2		*The range of prices for the operation object to comply with the "arm's length" principle*	
2	BCA	543.1	$/t	SWOT	500.7	1		
3	Euronext	521.0	$/t	Euronext	521.1	2	▶	
4	NYBOT	497.2	$/t	BCA	531.1	3	**from**	**500.7** **$/t**
5	WCE	555.3	$/t	LIFFE	544.2		**to**	**534.1** **$/t**
6	LIFFE	544.2	$/t	WCE	555.3		*Price quotation as of 12.08.22 year*	

Modeling profit from the operation depending on the change in the transfer price

Management cost (before holding costs)	$/t	479.4			
EBITDA of operations to the distribution of holding costs	**from**	21.3	**$/t**	▶	208,740 $
	to	54.7	**$/t**	▶	536,060 $

Figure 4. Management model for determining transfer pricing using the comparable uncontrolled price method.

The programming specifics and logic of the functioning of the management model are described in Table 1.

The integration of databases into the transfer pricing management information system, along with the ability to select data sources (e.g., exchanges), enables the transfer pricing manager to identify a range of transfer prices that comply with the arm's length principle. This, in turn, allows the manager to model the potential profit from a controlled transaction [23,34,37]. Based on the chosen comparison base (e.g., exchanges with relevant price quotations), the manager can propose alternative transfer price scenarios, each accompanied by a projected profit interval for the transaction.

Table 1. Programming of the management model for determining the transfer price using the comparable uncontrolled price method.

No.	Model Parameters	Symbolic Notation	Source/Calculation
1	The method applied	#method	Functional module of the ISMCT "Legislation"/handbook "Transfer Pricing Methods"
2	Operation object	#object	Functional module of the ISMCT "Legislation"/handbook "Raw Materials"
3	Operation volume	#volume	Manual input by the manager (based on information from the commercial department)
4	Comparison basis	#exchange	Functional module of the TPCMIS "Benchmarking"/database "Exchanges"
5	Calculation of the transfer price range	#calculation	LARGE (1:n, COUNTIF (#exchange, "✔")) → COUNT (LARGE (1:n, COUNTIF (#exchange, "✔"))) × 0.25 → COUNT (LARGE (1:n, COUNTIF (#exchange, "✔"))) × 0.75 → from #lowest_price to #highest price
6	Management cost (before holding expenses)	#cost	Functional module of the TPCMIS "Analysis and Analytics"/tool "Data Export from CIS"/module "Management Accounting"/segment "Agricultural Production"/Analytics by Crops/Management Cost
7	EBITDA operations	#ebitda_op	from (#lowest_price − #cost) × #volume to (#highest_price − #cost) × #volume

4.2. Business Operation 2

The business unit engaged in bioethanol production (Poland) sells the finished product—bioethanol—to a trading house operating in Ukraine, which is responsible for its resale or further distribution to third-party companies.

The subject of this commercial transaction, which qualifies as a controlled transaction, is the sale of bioethanol intended for resale [31]. In this case, the resale price method is the most appropriate approach to verify compliance with the arm's length principle [23]. The management model for determining the transfer price—factoring in its verification using the resale price method—is illustrated in Figure 5.

The programming specifics and operational logic of the management model are presented in Table 2.

Table 2. Programming of the management model for determining transfer pricing using the resale price method.

No.	Model Parameters	Symbolic Notation	Source/Calculation
1	The method applied	#method	Functional module of the ISMCT "Legislation"/handbook "Transfer Pricing Methods"
2	Operation object	#object	Functional module of the ISMCT "Legislation"/handbook "Final product"
3	Operation volume	#volume	Manual input by the manager (based on information from the commercial department)
4	Comparison basis	#exchange	Functional module of the TPCMIS "Benchmarking"/database "Residents"
5	Calculation of the transfer price range	#calculation	for the comparison database: gross_margin0 = (#sale_price0 − #purchase_price0)/#sale_price0 for the company: #sale_price1 = #purchase_price1/ (1 − gross_margin0)
6	EBITDA operations	#ebitda_op	(#sale_price1 − #purchase_price1) × #volume

Determining the transfer price within the operation falling under the "controlled"criteria, *taking into account its compliance with the "arm's length" principle*

1	***The method used to assess compliance with the "arm's length" principle:***		resale prices
2	***The object of the operation***		bioethanol
3	***Volume of operation, tone***		5000
4	***Comparison base*** *(select the necessary)*	✓	transactions of a third party (resident)
			third party (non-resident) operations

Calculation of the transfer price range for the transaction object

Counterparties with transactions carried out under similar conditions were identifie: 2

		Operations of third party		*Alternatives for companies (residents)*	
		Company A	**Company B**	**1-st**	**2-nd**
Realization price	$/m²	812	850	**785**	**820**
Purchase price	$/m²	449	450	434	
Gross profit	$/m²	363	400	351	386
Gross profitability	**%**	**45%**	**47%**	**45%**	**47%**

Modeling the profit from the transaction depending on the change in the transfer price

EBITDA of operations to the distribution of holding costs	**from**	351	**$/m²**	▶	1,754,365 $
	to	386	**$/m²**	▶	1,928,880 $

Figure 5. Management model for determining the transfer price using the resale price method.

A distinctive feature of this management model is the use of data from the Benchmarking functional module within the transfer pricing operations management information system. As previously noted, information exchange regarding transfer pricing operations is one of the key tools for building trust between tax authorities and businesses. Therefore, jointly developing this information base in cooperation with tax authorities can significantly simplify the process for companies to confirm and report their compliance with tax legislation in transfer pricing. By utilizing data from the Residents or Non-Residents databases to search for third-party transactions under comparable conditions, a company can determine a benchmark transfer price for the transaction object based on the parameters of a comparable transaction. If several such transactions are identified, the transfer pricing manager can present a range of options to the management, including an analysis of the potential profit associated with each transaction scenario [38,39].

4.3. Business Operation 3

The business unit engaged in oil extraction production (Poland) supplies its products to business units involved in animal husbandry (Ukraine), providing them with finished goods—specifically, rapeseed meal used for animal feed.

The object of this business operation, which falls under the criteria of a controlled transaction, is rapeseed meal. In this case, it is appropriate to apply the cost-plus method to verify compliance with the arm's length principle. The management model for determining the transfer price, considering its verification using the cost-plus method to ensure compliance with the arm's length principle, is presented in Figure 6 (the final transfer sale price set by the company is highlighted in color).

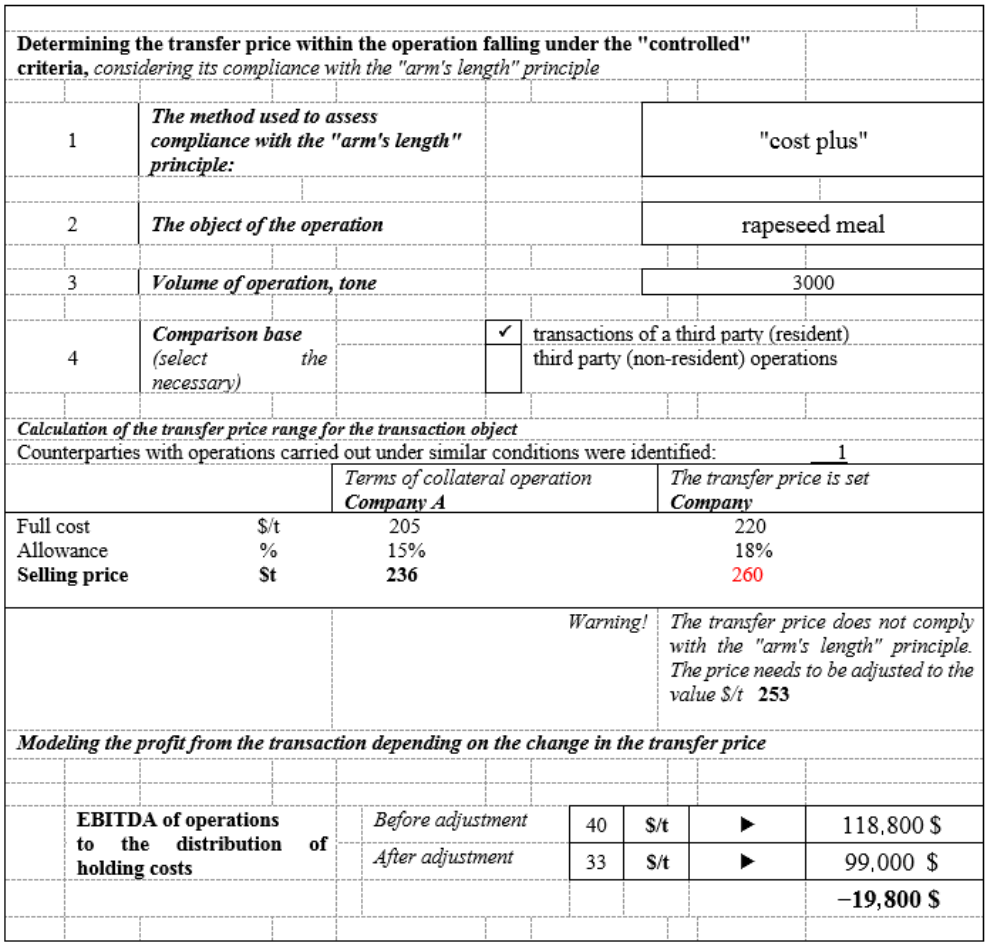


Figure 6. Management model for determining the transfer price using the cost-plus method.

The programming specifics and operational logic of the management model are detailed in Table 3.

Table 3. Programming of the management model for determining the transfer price using the cost-plus method.

No.	Model Parameters	Symbolic Notation	Source/Calculation
1	The method applied	#method	Functional module of the ISMCT "Legislation"/handbook "Transfer Pricing Methods"
2	Operation object	#object	Functional module of the ISMCT "Legislation"/handbook "Final product"
3	Operation volume	#volume	Manual input by the manager (based on information from the commercial department)
4	Comparison basis	#exchange	Functional module of the TPCMIS "Benchmarking"/database "Residents"
5	Calculation of the transfer price range	#calculation	for the comparison database: #sale_price0 = #cost0 × (1 + #prem%0) for the company: #sale_price1 = #cost1 × (1 + #prem%0)
6	EBITDA operations	#ebitda_op	(#sale_price1 − #cost1) × #volume

The peculiarity of the management model for determining the transfer price using the cost-plus method lies in comparing the operation of a third party, based on which the model can inform the user about the need to adjust the transfer price. Thus, by modeling the profit from the transfer pricing operation, the manager has the opportunity to determine

the amount of potential profit loss through adjustment of the transfer price. This model is more useful for use both in the planning stage and in the post-control stage.

4.4. Business Operation 4

The business unit engaged in sugar production in Ukraine supplies granulated meal (for fuel purposes) and molasses (for production purposes) to business units involved in bioethanol and oil extraction production in Poland.

The objects of this business operation, falling under the criteria of controlled, are granulated fodder and molasses. In this case, due to the complexity or impossibility of applying traditional methods, it is advisable to use the net profit method to verify compliance with the arm's length principle. The management model for determining the transfer price, taking into account its verification by the net profit method, is shown in Figure 7. The selling price in the company's transactions with third parties is highlighted in color (green for grunge, red for molasses).

The specifics of programming and the logic of functioning of the management model are described in Table 4.

This management model operates on a logic similar to the two previous ones, but it requires more detailed information for its implementation. The effectiveness of the transfer pricing model using the net profit method lies in its ability to adjust the price (if it does not comply with the arm's length principle) and simultaneously increase the transfer price (if there is a margin). The result of profit modeling from transfer pricing operations will inform the model user about the planned profit, adjusted planned profit with details regarding the change in the transfer price for a particular object.

4.5. Business Operation 5

The business unit engaged in sugar production in Ukraine supplies by-products—namely, dried pulp and molasses—to affiliated business units in Poland engaged in bioethanol production, where these inputs are utilized for biogas generation. The resulting profits from this vertically integrated operation are subsequently distributed via a trading entity, based on a predetermined profit-sharing ratio of 70% to 30%.

Table 4. Programming of the management model for determining transfer pricing using the net profit method.

No.	Model Parameters	Symbolic Notation	Source/Calculation
1	The method applied	#method	Functional module of the ISMCT "Legislation"/handbook "Transfer Pricing Methods"
2	Operation object	#object	Functional module of the ISMCT "Legislation"/handbook "Final product"
3	Operation volume	#volume	Manual input by the manager (based on information from the commercial department)
4	Comparison basis	#exchange	Functional module of the TPCMIS "Benchmarking"/database "Residents"
5	Calculation of the transfer price range	#calculation	for the comparison database: #profitability0 = (#sale_price0 − #cost0 − #other_cost0)/#sale_price0 for the company: #sale_price1 = (#cost1 − #other_cost1)/(1 − #profitability0)
6	EBITDA operations	#ebitda_op	(#sale_price1 − #cost1 − #other_cost1) × #volume

Determining the transfer price within the operation falling under the "controlled" criteria, *considering its compliance with the "arm's length" principle*

1	*The method used to assess compliance with the "arm's length" principle:*		net profit
2	*The object of the operation*		granulated molasses pulp
3	*Volume of operation, tone*		12,000 5000
4	*Comparison base (select the necessary)*	✓	transactions of a third party (resident) third party (non-resident) operations

Calculation of the transfer price range for the transaction object

Counterparties with operations carried out under similar conditions were identified: 1

		Primary surgery		*Company operation third parties*	
		grunge	**molasses**	**grunge**	**molasses**
Production cost	$/t	91	48	72	44
Sale price	$/t	195	150	150	142
Selling expenses. distributed holding and other costs per unit of production	$/t	7	4	8	3
Sales volume	t	8000	3000	12,000	5000
Income (revenue) from sale	thous. $	1560	450	1800	710
Cost of realization	thous. $	728	144	864	220
distributed holding and other expenses	thous. $	56	12	96	15
Profit from operating activities before taxation	thous. $	776	294	840	475
Profitability of operating activities before taxation	**%**	**50%**	**65%**	**47%**	**67%**

Warning! *The transfer price does not comply with the "arm's length" principle. The price needs to be adjusted to the value $/t* **136**

Modeling the profit from the transaction depending on the change in the transfer price

EBITDA operations (according to price scenarios)	*Before adjustment*	▶	1315 $
	After adjustment	▶	1393 $
taking into account the increase in the price of grunge (+)			*110 thousand $*
taking into account the decrease (–)			*– 32 thousand $*

Figure 7. Management model for determining the transfer price using the net profit method.

This business transaction qualifies as a controlled transaction under international transfer pricing regulations. The key objects of the transaction—dried distillers' grains with solubles (DDGS) and molasses—serve as raw materials in the bioethanol production process. Given the integrated nature of the operations and the joint contribution of the parties involved, the profit split method is considered the most appropriate for ensuring adherence to the arm's length principle.

A managerial model for determining transfer prices, along with its verification based on the profit split method, is presented in Figure 8 (the final percentage of distribution between resident companies is highlighted in color). The technical parameters and algorithmic logic underpinning this model are detailed in Table 5.

Among the various approaches to transfer pricing, the model based on the profit split method is the most transparent and analytically robust, particularly for interrelated transactions characterized by high integration and mutual interdependence [23,31]. However, the effective application of this model necessitates access to a comprehensive database of comparable transactions involving independent entities. Should the distribution of profits within the controlled transaction deviate from the range established by compa-

rable uncontrolled transactions, the model will indicate non-compliance with the arm's length principle.

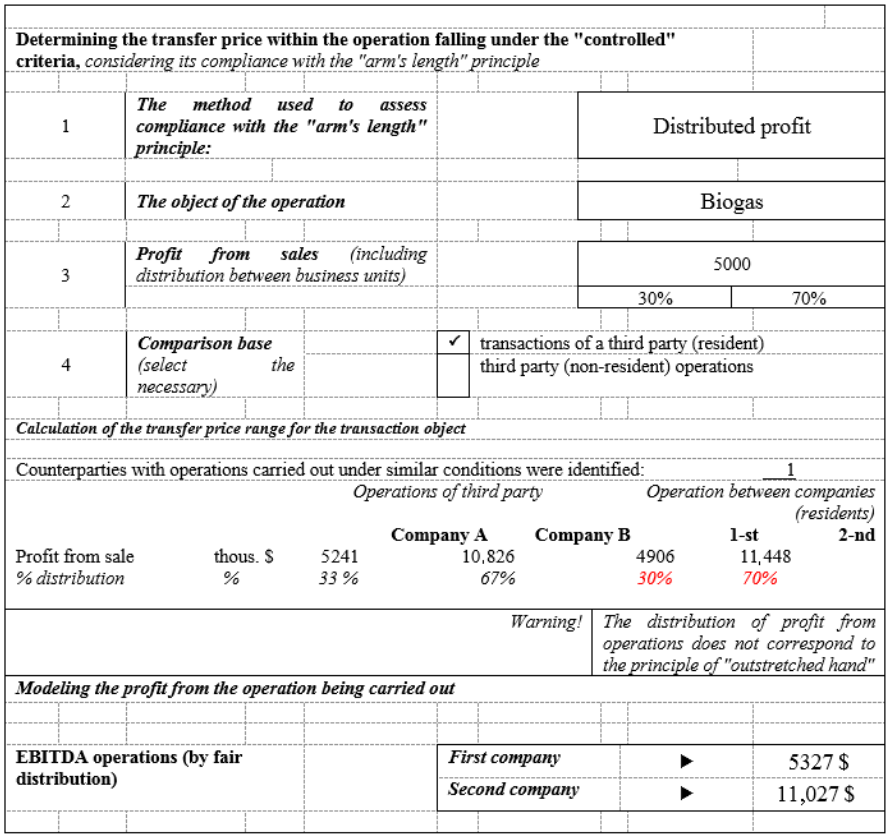


Figure 8. Management model for determining transfer pricing using the distributed profit method.

Table 5. Programming of the managerial model for determining the transfer price using the profit split method.

No.	Model Parameters	Symbolic Notation	Source/Calculation
1	The method applied	#method	Functional module of the ISMCT "Legislation"/handbook "Transfer Pricing Methods"
2	Operation object	#object	Functional module of the ISMCT "Legislation"/handbook "Final product"
3	Operation volume	#profit	Manual input by the manager (based on information from the commercial department)
4	Comparison basis	#exchange	Functional module of the TPCMIS "Benchmarking"/database "Residents"
5	Calculation of EBITDA operation	#ebitda_op	for the comparison database: #d01(profit0) = #profit01/(#profit01 + #profit02); #d02(profit0) = #profit02/(#profit01 + #profit02) for the company: #profit11 = #profit1 × #d01(profit0) #profit12 = #profit1 × #d02(profit0)

5. Discussion

Our proposed financial control framework for managing transfer pricing transactions, which integrates key performance indicators (KPIs) and the balanced scorecard (BSC) with tax compliance principles, offers clear advantages over traditional approaches that focus on tax optimization or isolated financial metrics.

Traditional transfer pricing methods such as the comparable uncontrolled price (CUP), resale price (RPM), cost-plus method (CPM), and transaction net margin method (TNMM), as set out in the OECD Transfer Pricing Guidelines for Multinational Enterprises and

Tax Administrations [5], primarily aim to establish an arm's length price for individual transactions or entities based on comparable uncontrolled transactions or profitability levels. When applied on their own, these methods may not fully capture the strategic objectives of a diversified holding company, particularly in the agricultural context.

Our model goes beyond simple compliance by explicitly incorporating the balanced scorecard (BSC) framework [14,16,40]. This enables a holistic assessment of transfer pricing decisions, taking into account not only financial results but also market, production, and learning and development perspectives through the use of specific KPIs. This holistic approach ensures that transfer prices contribute to the sustainable and stable performance and growth of the entire company, balancing the interests of all stakeholders, including the tax authorities and internal business units.

The practical application demonstrated through various business transactions (e.g., sales of sunflower seed, bioethanol, and rapeseed meal) highlights how our model can determine transfer prices that deliver equal EBITDA margins across segments while respecting the arm's length principle, a new integration that is clearly not central to traditional methods. Although existing models such as those by Kulinich [4] or Grigorii, Grosu, and Melega [7] address specific aspects of transfer pricing, they do not offer an integrated perspective of strategic management based on KPIs. Two-tier models of accounting policies and risk assessment matrices provide valuable information on specific aspects, but our study combines the KPI approach with ensuring the arm's length principle in intra-group transactions to achieve a balanced development of business units in the holding structure.

6. Conclusions

The application of transfer pricing as a mechanism for setting prices in intra-group transactions enables organizations to exert significant influence over the financial outcomes of individual business units. This practice is particularly relevant in multinational enterprises, where internal transactions across jurisdictions are subject to both managerial and regulatory scrutiny. The development of automated managerial models for determining transfer prices serves as a valuable tool for corporate leadership, facilitating informed decision-making regarding the appropriate pricing of controlled transactions. These models also provide analytical support for the preparation of internal management reports and transfer pricing documentation, thereby enhancing transparency and compliance.

The model highlights two fundamental principles: (1) tax compliance through verification of transfer prices' adherence to the arm's length principle and (2) balancing stakeholder interests via the KPI system (BSC), which aligns tax requirements with managerial objectives.

The management accounting system, in this context, performs a dual role: it functions as a primary source of information for strategic and operational decision-making by internal stakeholders, and it acts as a mechanism for post-decision monitoring and control. The process of managing transfer pricing operations, when aligned with tax compliance requirements and the need to balance stakeholder interests, relies on a comprehensive managerial accounting framework. This framework incorporates key components such as a balanced scorecard of performance indicators at both the corporate and unit levels, value chain analysis, cost–volume–profit (CVP) analysis, and the determination of arm's length pricing ranges based on comparable data. The integration of these elements into a unified and automated management accounting model constitutes a practical solution for achieving both compliance and performance objectives.

The informational value of this integrated approach is reflected in its capacity to generate reliable and decision-relevant data for both managerial accounting systems and transfer pricing control frameworks. The development of such applied solutions—including

both general management accounting models and specialized models for transfer pricing determination—can be effectively implemented within the company's broader management information system. This integration not only strengthens compliance with tax regulations but also contributes to the attainment of strategic key performance indicators, making it a critical element of modern enterprise management practices.

Future research will focus on exploring the integration of advanced analytics or artificial intelligence to improve the predictive capabilities of the model and automation. The implications of such a system for management incentives and its extension to other industries with complex value chains will be areas for further study.

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