METHODOLOGY OF MODELING THE OPTIMAL MANAGEMENT SYSTEM OF THE INTERNATIONAL CONTRACT PARAMETERS IN THE CONDITIONS OF ECONOMIC UNCERTAINTY

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The paper suggests a methodological tool ware necessary for making adequate solutions in the conditions of economic uncertainty. These solutions allow to enhance the efficiency of a company's international trade including by way of optimization of the model of managing the purchase amount under strategically important import contracts.

Keywords: international trade, import contract, international supplier, Wald criterion, Hurwitz criterion, Savage criterion, profitability matrix, methods, management model, optimal decision, optimization procedures, strategy, efficiency.

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Nowadays, in the period of volatility and drastic changes going on in the world economy in general and in the brewery industry in particular, the businesses involved in international trade should build such a strategy that would allow them to operate effectively on the world market. When developing an international trade strategy any business entity should pay special attention to the methods of evaluation of contract parameters, the optimal values of which should be chosen in compliance with the policy of working capital management, as the modern approaches to organizing the management including not only debts or trade credits, but also stock, allow the efficiency enhancement of international trade taking into consideration field-specific features of its functioning. It can be explained in the following way: the wrong concept of the working capital management means cost-ineffective investment in assets. The failure to use these assets in the business processes accompanying international trade carried out by a business entity causes the decrease of asset liquidity and characterizes inability of a business entity to invest into assets which would make these activities profitable. Therefore, we argue that the stock should be viewed not as a non-performing asset, but as an important component of investment operations carried out by an importing company.

Due to the fact that the optimal stock increases the economic benefit of a business entity and ensures its flexibility on the international trade market, this indicator can be regarded as an efficiency criterion of the company's activity in general and the import trade operations in particular. However, there should be a balance between the advantages, which the optimal stock provides (for example, increase in the number of customers, who will get the product with-

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out any delays, supply disruptions will not affect the production cycle) and expenditures involved in carrying out this economic activity, such as purchase, storage and utilization.

It is worthwhile mentioning that international trade carried out in compliance with the current legislation is one the international trade activities. It means that when a business entity is involved in international trade, it can incur certain expenditures. The data related to these expenditures can be found in the source accounting documents, accounting records and accounting (financial) reporting. At present is it deemed impossible to identify a converging evidence for expenditure classification accompanying international trade. It is mainly due to their adaptation to ever changing conditions of international trade and differentiation.

We believe, that in terms of analysis of expenditures connected with stock, they can be classified as follows:

- storage expenditures (insurance, storage, loading and unloading, lost income from investment in other assets);
- order expenditures (administrative expenditures, mailing charges, quality control, working hours of computer equipment, certification);
- per-unit expenditures;
- losses incurred due to stock shortages (loss of sales revenue due to customer loss, damage to goodwill in the business community).

As the international trade is evolving, there will be new objects for research, determining type-specific expenditure breakdown characteristic for this economic activity. Therefore, the criterion of expenditure classification, which takes place when a business entity is involved in international trade, is the subject analysis coupled with the current tasks, which is the necessary condition of effective application of specific knowledge when making optimal decisions, including the cases of stock management.

When regarding the core of international trade efficiency, it is necessary to determine the criteria, which should be met by the company's stock control policy. Taking into consideration the modern state of international trade, we believe, the general requirements for the stock volume may be as follows:

- ensure minimum expenditures caused by economic life of a business entity involved in international trade.
- provide customers with the level of service in compliance with the company's strategy,
- ensure smooth operation of the production unit
- ensure a company's operation under economic uncertainty.

We consider this approach to be appropriate for its rationale and consistency with the obtained economic data, which can undergo qualitative and quantitative assessment, ability to identify destructive factors, reducing the efficiency of a company's international trade.

Regardless of the fact that efficiency and expenditures characteristic of different aspects of international trade are interrelated, its definition may not provide a complete characteristics of the whole variety of economic situations, concerning the efficiency assessment of the company's international trade. Therefore, in this respect, the core of the "international trade efficiency" defini-

tion should be, in our view, the purpose pursued by the company applying this category. In this case, the company's objective is to gain the maximum effect at minimum expenditures related to the international trade, carried out by a company over a period of time.

Economic literature review in the field of stock control, expenditure optimization [1] and author's research [4] revealed that import contract expenditures C_k , regarded as the function of the order quantity q , can be represented as follows:

$$C_k = C_n N_k / q + C_h q / 2 + p_n N_k, \quad (1)$$

where N_k – is the quantity demanded within the sales contract; C_n – overhead supply costs within the sales contract; C_h – storage expenditures per unit; p_n – purchase price per unit.

Since the difference between revenues and expenditures from the international trade generates a financial result (profit or loss) of a particular economic activity, then the revenue within the import contract P_k is defined as follows:

$$P_k = p_p N_k - C_k, \quad (2)$$

where p_p – the sales price per unit.

Formalizing the task of revenue maximization within the import contract P_k allows to represent it as follows:

$$P_k = p_p N_k - C_n N_k / q - C_h q / 2 - p_n N_k \rightarrow \max_{q>0}, \quad (3)$$

Whereas, the problem of expenditures minimization within the import contract can be represented as follows:

$$C_k \rightarrow \min_{q>0}. \quad (4)$$

For a deterministic model, using revenue optimization, the best amount of order can be defined using the following correlation:

$$q_k = \sqrt{2C_n N_k / C_h}. \quad (5)$$

In our view, when searching for the optimal import solution under economic uncertainty, it is necessary to take into consideration the time value of money in order to minimize the total costs taking into consideration the transaction costs and interest rates. Time value of money is the sum of money, which the company intends to gain as a result of international trade contract completion. The company contributes its working capital into this contract. Provided the time value of money is a refundable amount, it is vulnerable to such factors as inflation, risk and deferred consumption.

Since the current value of the working capital is higher than its value, for example, half a year later, then a business entity should get compensated for refusal from consumption today in order to consume a larger amount in the future. Inflation in its turn causes depreciation over time. Therefore, a company should get compensated for the purchasing power loss. The future cash flows are risky, as the funds may not be received on the account or can be transferred in a smaller amount, which also should be compensated to an international trade agent, who might use these funds in a different way to gain a better profit. Any contribution of a company into international trade contracts aims to gain

revenue, therefore, these contracts should establish such cash flows, which would ensure sufficient income. Taking into consideration the time value of money when assessing the purchase amount, makes it possible to discount the cash flows in compliance with the rate of a bank credit used to make an international trade contract. The previously mentioned fact enables us to state that expressions (1-3, 5) should be transformed. As a result of mathematical transformations, formula (3), which represents a model of stock volume optimization of an import contract under economic uncertainty, taking into consideration the time value of money will be represented as follows [1, p. 270]:

$$\Pi_{\text{KH}}^A = \gamma P_p^A - C_n^A - C_h^A - P_n^A, \quad (6)$$

Where Π_{KH}^A – the intended revenue from the import contract;

γ – coefficient taking into consideration different revenue losses, contingent on the objection of the product quality;

$$P_p^A = q P_p [(1 + i_q)^n - 1] / i_q; \quad (7)$$

q – economic quantity of an order in the framework of import contract;

P_p – sales price per unit;

$$i_q = \sqrt[n]{1 + i} - 1; \quad (8)$$

i – interest rate on credit;

n – the number of goods delivered within an import contract in the time period under study;

$$C_n^A = C_n [1 + (iq)/(2V)] [(1 + i_q)^n - 1] / i_q; \quad (9)$$

C_n – expenditures per order within an import contract;

V – purchase amount within an import contract;

$$C_h^A = q^2 C_h [(1 + i_q)^n - 1] / [2V i_q]; \quad (10)$$

C_h – storage expenditures per unit in the time period under study;

$$P_n^A = q P_n [1 + (iq)/(2V)] [(1 + i_q)^n - 1] / i_q; \quad (11)$$

P_n – purchase price per unit of raw material under the import contract.

Thus, under uncertainty, the optimal purchase amount within an import contract, defined by expression (5) taking into consideration the time value of money and the provisions of Brodetsky G.L. research work [1, p. 264], can be represented as follows:

$$q_{\text{опт}}^A = \sqrt{\frac{2C_n V}{C_h + P_n(i/100)}}. \quad (12)$$

Thus, the purchase amount under the terms of the import contract is optimal not only when the overall expenditures are optimized, but also when the maximum level revenue is gained upon its fulfillment taking into consideration the time value of money.

Volatility of the international market results in the fact that a company is not aware of the purchase amount value that would enhance the efficiency of its international and overall activity, therefore, it is not an easy task to gain profit maximization under the import contract. In our view, the models, which assess the purchase amount and the limits of uncertain parameters variation in the absence of economic situation forecast, are of practical importance. Simulation of the event development within the prescribed limits addresses the issue of

purchase volume optimization under the import contract. In the context of formalizing the model of the purchase amount a business entity can set random scenarios taking into consideration the required accuracy of the forecast and the time necessary for the analysis.

For the reasons of practical rationale, the aforesaid enables us to suggest the methodology for selection of the most optimal option for stock regulation based on the purchase amount modeling under import contracts in the conditions of economic uncertainty, which can be specified in compliance with the subject and the object of research. In our view the structure of methodology, shown in Figure 1 could feature the following stages.

Stage 1: Setting a goal and objectives. Goal-oriented character of this method allows us determine the factors facilitating international trade including situations when a company has to manage the purchase amounts under the terms of import contracts. In order to achieve the set goal it is necessary to address the following objectives:

- to search for economic information and identify data on destructive factors;
- to determine the objects and facts of the economic activity of a business entity in the sphere of international trade which represent interest for research;
- to reveal the techniques and conditions for optimization of the strategy of purchase amount management under the import contract in the conditions of uncertainty;
- to ascertain the criteria used in the procedures of decision optimization;
- to determine the optimal value of the purchase amount under the import contract within the efficiency management of a company's international trade.

Stage 2: Determining the parameters of the model. At this stage a business entity develops the parameters for the model of purchase amount management within which different scenarios projected by a company are going to be analyzed.

Stage 3: Development of the complete event group. In order to make optimal decisions under uncertainty of international trade it is particularly important to develop a complete event group. On the one hand, a company should take into account all the random events that might exert an impact on the efficiency of this type of activity, on the other hand, the staff of a company should have scientific expertise in the field.

Stage 4: Formalizing the list of alternatives under analysis. In order to find an optimal solution in the conditions of uncertainty at this stage it is necessary to clearly define the alternatives of the analyzed decisions, set by an economic entity using general scientific and specific methodological approaches depending on the analysis objectives.

Stage 5: Building a utility matrix. In order to find out an optimal solution it is necessary to build a utility matrix, the elements of which demonstrate economic result as applicable to any alternative under study and any event of the complete group.

Source: Compiled by the author

Fig. 1. Methodology for selecting the optimal purchase amount under the import contract

Stage 6: Selecting the criteria for determining the optimal decision. This stage is related to the choice of criteria, because when it comes to optimization of the purchase amount under uncertainty, a whole range of criteria can be used. Prioritizing one criterion over another, a company should take into consideration their specific features, the mechanism of selecting an optimal decision, which determine the specific application of the decision making criterion.

Stage 7: Determining the optimal decision. In order to find an optimal decision under uncertainty it is necessary to carry out a selection base on the criterion chosen by a company.

In order to gain an adequate idea of the opportunities of the method described above, let us refer to its practical implementation, which would enable a business entity to determine the optimal purchase amount under the import contract with the efficiency management of international trade. Effectiveness of this activity is provided by the system of stock management as well, then for

the purpose of prognostication of the purchase amount under the import contract a company analyses the situation represented in the model with the parameters presented in Table 1.

In the framework of the model for each of the four factors including product demand, selling price, losses incurred during the selling of a product supplied by an international supplier 1, and losses incurred during the selling of a product purchased from an international supplier 2, we considered two scenarios. The analysis of a complete even group exerting an impact on the economic result required the analysis of 16 different random events.

Table 1

Parameters of the optimized model of purchase
 amount under the import contracts

Parameters of the optimized model	Symbol	Parameter value
Purchase amount of the import product, euro		
- scenario I	V_1	16,800.00
- scenario II	V_2	25,200.00
Annual storage expenditures per unit, euro/l.	C_h	1.26
Overhead expenses per every procurement of supplier 1, euro	C_{n_1}	42
Overhead expenses per every procurement of supplier 2, euro	C_{n_2}	31.5
Purchasing price per product unit of supplier 1, euro/kg	P_{n_1}	6.3
Purchasing price per product unit of supplier 1, euro/kg	P_{n_2}	5.25
Selling price per product unit, euro/l		
- scenario I	P_{p_1}	6.72
- scenario II	P_{p_2}	7.56
Interest rate, %	i	14
Decreasing coefficient		
- favourable outcome of selling the products of supplier 1	γ_{1+}	1
- unfavourable outcome of selling the products of supplier 1	γ_{1-}	0.87
- favourable outcome of selling the products of supplier 2	γ_{2+}	1
- unfavourable outcome of selling the products of supplier 2	γ_{2-}	0.65

When formalizing the model of optimization of the purchase amount under the import contracts we consider the possibility of purchasing from several foreign suppliers establishing framework contracts with a business entity with different supply terms, prices, terms of payment and delivery deadlines. The model timeframe is 1 year. For the purpose of determining the selling price per unit of the import good and customer demand within the mode we analyzed two situations: the selling price per unit of the import good can be low and high; the demand to the import good can be strong or weak.

Taking into consideration the possible revenue losses as a result complaints about the quality of goods purchased from foreign suppliers, for the model parameters we introduced coefficient γ , which was analyzed for two situations. One of

them indicates a favourable outcome of profit generation (γ_+), when there is no weakening in the demand on the import product, and $\gamma = 1$. The other indicates an unfavourable outcome of profit generation (γ_-), when the demand for the product is weakening and $0 < \gamma < 1$.

Profit maximization under the import contract with the introduced coefficient γ for the account of losses arising as a result of complaints about the quality of goods, can be represented as follows:

$$\Pi_{\text{кн}}^A = \gamma P_p^A - C_n^A - C_h^A - P_n^A \rightarrow \max_{q>0}. \quad (13)$$

The search of the optimal solution for this situation is hindered due to the fact that the combinations of situations in which the valued of the above mentioned model could be implemented under uncertainty are unknown beforehand. For example, in a situation when the purchase price offered by a foreign supplier 1 (p_{n_1}) is lower in comparison with the purchase price offered by a foreign supplier 2 (p_{n_2}), and the supply overheads will be lower if the importer makes a contract with supplier 1 and not with supplier 2 ($C_{n_1} < C_{n_2}$). Under unfavourable outcome of revenue generation the decreasing coefficient for the revenue featured by supplier 1 will be higher ($\gamma_{1-} > \gamma_{2-}$). Thus, the decision of a business entity to purchase from supplier 1 might turn out to be ineffective, if the possibility of risk diversification related to profit losses when implementing a combination of situations γ_{1-} and γ_{2-} is ignored.

Formalization was carried out in compliance with the developed methodology. Formalized groups of events, which can be characterized as random and which could exert an impact on the ultimate economic outcome allowed to compile the following Table 2.

According to the suggested methodology in order to make the best solution in the conditions of uncertainty, taking into consideration the time value of money, it is necessary to formalize the list of analyzed alternatives, set by a business entity. In our view, the procedure of answer search for such tasks can be carried out by selecting of different options for the share of goods supplied by a foreign supplier, or a variety of values of the purchase amount under the import contract (V), overheads related to supply (C_{n_1} or C_{n_2}) depending on the share of the import good, which will be supplied by every foreign supplier.

The relation ratio of the import good shares between the foreign suppliers, within the analyzed methodology can vary. Analyzing a different number of options, characterizing redistribution of the shares of the supplied import goods between the foreign suppliers results in an increase in the number of analyzed alternative decisions. Thus, the selling price per import unit, in our view, does not depend on the choice of a supplier, as it is predetermined in accordance with the market economy.

In order to comply with the developed methodology, formalization of a numerous alternatives, analyzed by the importer (in our case comprising six decisions), allowed to represent them in Table 3.

Table 2

Parameters of model optimization
 of the purchase amount under the import contract

Random event	Event contents
1	2
B_1	Low revenue, low selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 1 or supplier 2
B_2	High revenue, low selling price per unit, no revenue losses arising as a result of quality claims asserted to suppliers
B_3	Low revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to suppliers
B_4	High revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to suppliers
B_5	Low revenue, low selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 2 but there are such to supplier 1
B_6	High revenue, low selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 2 but there are such to supplier 1
B_7	Low revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 2 but there are such to supplier 1
B_8	High revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 2 but there are such to supplier 1
B_9	Low revenue, low selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 1 but there are such to supplier 2
B_{10}	High revenue, low selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 1 but there are such to supplier 2
B_{11}	Low revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 1 but there are such to supplier 2
B_{12}	High revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 1 but there are such to supplier 2
B_{13}	Low revenue, low selling price per unit, revenue losses arising as a result of quality claims asserted to both suppliers
B_{14}	High revenue, low selling price per unit, there are revenue losses arising as a result of quality claims asserted to both suppliers
B_{15}	Low revenue, high selling price per unit, there are revenue losses arising as a result of quality claims asserted to both suppliers
B_{16}	High revenue, high selling price per unit, no revenue losses arising as a result of quality claims asserted to supplier 1 but there are such to supplier 2

Table 3

A set of alternative solutions with the relevant
optimal purchase amount under the import contract

Solution	Contents of the alternative solution	Optimal purchase amount
S_1	The preferred purchase amount of product V_1 , which is going to be provided from supplier 1	$q_1^A = \sqrt{[2C_{n_1} V_1]/(C_h + P_n(i/100))}$
S_2	The preferred purchase amount of product V_1 , which is going to be provided from supplier 2	$q_2^A = \sqrt{[2C_{n_2} V_1]/(C_h + P_n(i/100))}$
S_3	The preferred purchase amount of product V_1 , which is going to be provided in equal parts by the two foreign suppliers	$q_{3_1}^A = \sqrt{[C_{n_1} V_1]/(C_h + P_n(i/100))};$ $q_{3_2}^A = \sqrt{[C_{n_2} V_1]/(C_h + P_n(i/100))}$
S_4	The preferred purchase amount of product V_2 , which is going to be provided by supplier 1	$q_4^A = \sqrt{[2C_{n_1} V_2]/(C_h + P_n(i/100))}$
S_5	The preferred purchase amount of product V_2 , which is going to be provided by supplier 2	$q_5^A = \sqrt{[2C_{n_2} V_2]/(C_h + P_n(i/100))}$
S_6	The preferred purchase amount of product V_2 , which is going to be provided in equal parts by the two foreign suppliers	$q_{6_1}^A = \sqrt{[C_{n_1} V_2]/(C_h + P_n(i/100))};$ $q_{6_2}^A = \sqrt{[C_{n_2} V_2]/(C_h + P_n(i/100))}$

Using the data from Table 1 we calculated an optimal amount of purchase under the import contract with regard to time value of money for every alternative solution undergoing analysis. Generalizing the computed results enabled us to represent the research outcomes in Table 4. For the purpose of further analysis we deem possible to round down the values of the optimal purchase volume obtained in Table 4 to the following values: q_1^A to 810 kg, q_2^A to 730 kg, $q_{3_1}^A$ to 575 kg, $q_{3_2}^A$ to 515 kg, q_4^A to 995 kg, q_5^A to 890 kg, $q_{6_1}^A$ to 700 kg and $q_{6_2}^A$ to 630 kg. Such rounding will not affect further discussion.

When making a list of solutions, we believe, it is necessary to take into consideration the possibility of diversification of the risks of loss arising as a result of product quality claims. Therefore, in our research we analyzed the solutions under which an import product was provided in equal parts by the two foreign supplies.

The further increase in the number of strategies of risk diversification results not only in an increase in the number of analyzed solutions, but also in the increase of expenditures. This occurs due to the fact that the overall cost related to import product supply is supplemented with an additional component ensuring the risk of import supply failures. As a result, the choice of alternative solutions when developing a strategy for purchase amount management under the import contract in the conditions of uncertainty, which fosters the importer to diversify import supplies requires further research.

Table 4

Optimal purchase amounts for alternative solutions

Solution	Optimal purchase amount	Calculation of the optimal purchase amount, kg.
S_1	$q_1^A = \sqrt{[2C_{n_1} V_1]/(C_h + P_{n_1} \left(\frac{i}{100}\right))}$	$q_1^A = \sqrt{[2 \times 42 \times 16800]/(1,26 + 6,3 \times 0,14)} = 812,0$
S_2	$q_2^A = \sqrt{[2C_{n_2} V_1]/(C_h + P_{n_2} \left(\frac{i}{100}\right))}$	$q_2^A = \sqrt{[2 \times 31,5 \times 16800]/(1,26 + 5,25 \times 0,14)} = 728,0$
S_3	$q_{3_1}^A = \sqrt{[C_{n_1} V_1]/(C_h + P_{n_1} \left(\frac{i}{100}\right))};$ $q_{3_2}^A = \sqrt{[C_{n_2} V_1]/(C_h + P_{n_2} \left(\frac{i}{100}\right))}$	$q_{3_1}^A = \sqrt{[42 \times 16800]/(1,26 + 6,3 \times 0,14)} = 573,94;$ $q_{3_2}^A = \sqrt{[31,5 \times 16800]/(1,26 + 5,25 \times 0,14)} = 515,04$
S_4	$q_4^A = \sqrt{[2C_{n_1} V_2]/(C_h + P_{n_1} \left(\frac{i}{100}\right))}$	$q_4^A = \sqrt{[2 \times 42 \times 25200]/(1,26 + 6,3 \times 0,14)} = 994,10$
S_5	$q_5^A = \sqrt{[2C_{n_2} V_2]/(C_h + P_{n_2} \left(\frac{i}{100}\right))}$	$q_5^A = \sqrt{[2 \times 31,5 \times 25200]/(1,26 + 5,25 \times 0,14)} = 892,07$
S_6	$q_{6_1}^A = \sqrt{[C_{n_1} V_2]/(C_h + P_{n_1} \left(\frac{i}{100}\right))};$ $q_{6_2}^A = \sqrt{[C_{n_2} V_2]/(C_h + P_{n_2} \left(\frac{i}{100}\right))}$	$q_{6_1}^A = \sqrt{[42 \times 25200]/(1,26 + 6,3 \times 0,14)} = 702,94;$ $q_{6_2}^A = \sqrt{[31,5 \times 25200]/(1,26 + 5,25 \times 0,14)} = 630,79$

According to the methodology described above and using the parameters for profit determination calculated with expression (6), we will build a utility matrix. Every element of this matrix represents expected profit gained as a result of solution S_j in the conditions of a business situation B_i . For the purpose of optimization of the strategy of the purchase amount management under the import contract taking into consideration the time value of money, this matrix will be represented as follows (Table 5).

Table 5

Utility matrix for selecting the optimal purchase
amount under the import contract

Solution Event	S_1	S_2	S_3	S_4	S_5	S_6
B_1	5,457.61	24,760.22	14,327.15	5,656.45	24,877.00	14,123.54
B_2	8,922.40	38,096.52	22,059.85	8,890.58	37,171.20	22,410.72
B_3	19,958.67	39,794.89	29,405.41	20,779.55	40,001.63	28,935.20
B_4	31,388.44	60,989.32	44,496.58	31,157.80	59,485.24	44,950.05
B_5	(9,618.54)	24,760.22	6,415.47	(10,071.58)	24,877.00	6,325.60
B_6	(14,444.96)	38,096.52	10,240.56	(14,267.33)	37,171.20	10,692.40
B_7	2,995.26	20,944.38	20,384.27	3,085.52	40,001.63	20,162.52
B_8	5,103.18	60,989.32	31,199.87	5,105.16	59,485.24	31,766.95
B_9	5,460.04	(17,336.87)	(6,302.92)	5,656.45	(17,471.99)	(6,354.68)
B_{10}	8,922.40	(26,003.32)	(8,941.83)	8,890.58	(25,308.11)	(9,150.14)
B_{11}	19,958.67	(7,564.34)	6,196.58	20,779.55	(7,640.98)	5,897.21
B_{12}	31,388.44	(11,123.00)	9,619.69	31,157.80	(10,803.98)	9,444.08
B_{13}	(9,618.54)	(17,336.87)	(14,321.72)	(10,071.58)	(17,471.99)	(14,152.62)
B_{14}	(14,442.28)	(26,003.32)	(20,761.13)	(14,267.33)	(25,308.11)	(20,868.46)
B_{15}	2,995.27	(7,564.34)	(2,824.56)	3,085.52	(7,640.98)	(2,875.48)
B_{16}	5,103.18	(11,123.00)	(3,677.02)	5,105.16	(10,803.98)	(3,739.02)
Wald criterion	(14,442.28)	(26,003.32)	(20,761.13)	(14,267.33)	(25,308.11)	(20,868.46)
Maximax criterion	31,388.44	60,989.32	44,496.58	31,157.80	59,485.24	44,950.05
Neutral criterion	6,220.58	11,523.52	8,594.77	6,292.02	12,538.75	8,597.99
Hurwitz criterion:						
- in case $\alpha = 0,7$	(694.94)	94.47	(1,183.81)	(639.79)	129.90	(1,122.90)
- in case $\alpha = 0,3$	17,638.42	34,891.53	24,919.27	17,530.26	34,047.24	25,204.50

The utility matrix developed in accordance with this methodology enables a business entity to choose the optimal solution, which in the conditions of uncertainty can be made based on of the following criteria: Savage criterion [2, p.102], Wald criterion [3, p.76], Hurwitz criterion [3, p.76], maximax criterion [2, p.102], and the neutral criterion [1, p. 38], which enable us to take into consideration the combination of factors exerting an impact on the efficiency of international trade. The outcomes of implementing optimization procedures based on Wald, Hurwitz, maximax, and neutral criteria are presented in Table 5. Data analysis carried out based on this table proves that, for example, by Wald criterion the optimal solution for the importer will be S_4 despite the fact that the solution S_1 slightly exceeds it. The solution made by this criterion reveals a more reliable foreign supplier for the company. The choice is determined by the amount of the expected profit losses due to probable complaints about quality of the sold product, even though another foreign supplier offers better purchasing prices.

By the maximax criterion, taken into consideration the time value of money, the optimal solution is S_2 , which is almost equivalent with S_5 . The choice made

by the business entity based on this criterion shows that it prefers a foreign supplier with offers a contract with the lowest purchasing price and at minimized supply expenditures. This solution is made regardless of the possible expenditures that an importer might incur due to the quality of the product.

Application of the neutral criterion, when choosing the optimal solution taking into consideration the time value of money fosters us to address S_5 as the best possible solution. It can be explained by the average weighted position of a business entity involved in international trade in relation to the possible values of its efficiency in cases when random situations described in a complete group of events occur.

The solution made under uncertainty taking into consideration the time value of money, based on Hurwitz criterion represents a compromise between the optimistic solution of maximax and the pessimistic one of Wald. In case when $\alpha = 0,7$ the optimal solution will be S_5 . In case when $\alpha = 0,3$ the optimal solution will be S_2 . In this case it is very important for the importer to refer to supplier 2 regardless of the value of α coefficient, which characterizes this particular foreign supplier as a reliable partner of a business entity, provided its attitude to any risk level is equal.

The choice of the best solution based on Savage test presumes building a loss matrix, which allowed us to represent the outcomes of the optimization procedure implementation when using this criterion in Table 6.

Table 6

Matrix of risks for the alternative solutions

Solution Event	S_1	S_2	S_3	S_4	S_5	S_6
B_1	19,419.39	116.78	10,549.85	19,220.55	0.00	10,753.46
B_2	29,174.12	0.00	16,036.67	29,205.94	925.32	15,685.80
B_3	20,042.96	206.74	10,596.22	19,222.08	0.00	11,066.43
B_4	29,600.88	0.00	16,492.74	29,831.52	1,504.08	16,039.27
B_5	34,495.54	116.78	18,461.53	34,948.58	0.00	18,551.40
B_6	52,541.48	0.00	27,855.96	52,363.85	925.32	27,404.12
B_7	37,006.37	19,057.25	19,617.36	36,916.11	0.00	19,839.11
B_8	55,886.14	0.00	29,789.45	55,884.16	1,504.08	29,222.37
B_9	196.41	22,993.32	11,959.37	0.00	23,128.44	12,011.13
B_{10}	0.00	34,925.72	17,864.23	31.82	34,230.51	18,072.55
B_{11}	820.88	28,343.89	14,582.97	0.00	28,420.53	14,882.34
B_{12}	0.00	42,511.44	21,768.75	230.64	42,192.42	21,944.36
B_{13}	0.00	7,718.34	4,703.18	453.04	7,853.45	4,534.08
B_{14}	174.95	11,735.99	6,493.80	0.00	11,040.78	6,601.13
B_{15}	90.24	10,649.86	5,910.08	0.00	10,726.49	5,960.99
B_{16}	1.98	16,228.16	8,782.17	0.00	15,909.14	8,844.17
Savage criterion	55,886.14	42,511.44	29,789.45	55,884.16	42,192.42	29,222.37

The results of the matrix analysis show that under Savage criterion, which minimizes the possible losses to the limit, the best solution will be S_6 . In the framework of this criterion the solution S_3 is also appropriate. The selected solution shows that a company adheres to the strategy of supply diversification

when the purchased products are distributed between the foreign suppliers in order to reallocate the risk of losses arising due to possible quality complaints.

Thus, the choice of the best possible solution when determining the amount of purchase under the import contract in the conditions of uncertainty is made based on optimization procedures fulfilled within every criterion.

For each analyzed solution, it is possible to determine how the time value of money influences the purchase amount under the import contract in the model enabling the importer choose the optimal solution of stock management. This fact is proved by the comparative analysis results of the import product purchase presented in Table 7 as applicable to the model, which takes into consideration the time value of money (12) and to model which does not take into consideration the discounting effect (5)

Table 7

Optimal purchase amount under the import
contact applicable to different models

Purchase amount, kg.	q_1	q_2	q_3		q_4	q_5	q_6	
Supplier	1	2	1	2	1	2	1	2
Model of purchase management	-	-	-	-	-	-	-	-
- without taking into account time value of money	1,058.30	916.52	748.33	648.07	1,296.15	1,122.50	916.52	793.73
- without taking into account time value of money (rounded)	1,060.00	920.00	750.00	650.00	1,300.00	1,120.00	920.00	795.00
- taking into account time value of money	810.00	730.00	575.00	515.00	995.00	890.00	700.00	630.00
Overstating of purchase amount, %	30.86	26.03	30.43	26.21	30.65	25.84	31.43	26.19

The analysis of results presented in Table 7, confirms that the amount of the purchase for the model which does not take into account the discount effect exceeds the indicator calculated for the model which takes into consideration the time value of money. And it is well justified, since when a business entity purchases some goods from supplier 1, the purchase amount will be overstated by 30%; when it purchases goods from supplier 2, the purchase amount will be overstated by 26%, which is going to tell upon the amount of expenditures, the costs of lost opportunities, when the funds are blocked in stock, and as a result will cause a downfall in the efficiency of international trade of the company as a whole and import operations in particular.

Result systematization enabled us to draw the following conclusions:

The paper provides grounds for the parameters on international trade contract as one of the controlling actions to ensure the efficiency of a company's international trade. It also gives arguments to analyze the purchase amount and revealing the factors optimizing this type of activity, including the ones that allow to manage stock under economic uncertainty.

By means of addressing the tasks set in our research, we justified that optimization strategy models used to manage purchase amounts under the import contracts in the conditions of uncertainty of international trade should be developed taking into consideration the time value of money. The obtained research results prove that when managing purchase amounts under import contracts in the conditions of uncertainty, the time value of money should be taken into consideration particularly when choosing the optimal solution in compliance with the methodology developed within our research. It presumes implementation of certain procedures, which make it possible to formalize the utility matrix, built with regard to the time value of money. Taking into account the peculiar features of the model undergoing analysis and manipulating with its elements, make it possible to find the best possible managerial solution.

There is a rationale in this approach due to the fact that upon determining the optimal amount of the purchases, the importer can formalize its attitude to the amount of expenditures in the format of preferred economic result.

The paper offered a step-by-step analysis to choose the optimal purchase amount of the import product. Thus the first stage here is setting the research goals, which are determined by the contents of the set questions. The parameters constituting the model are viewed as separate objects of research, which is well justified: every reference point in the research has its own information array and contributed to establishment of the ultimate economic result.

The paper also justifies that the consequent stages of optimal purchase amount selection under the import contract require formalizing a complete group of random events, which exert an impact on the ultimate economic result expected by a company and the list of analyzed alternative solutions. The results gained made it possible to group the factors facilitating optimization of the purchase amount management model under the import contracts. Using the categorizing provided in the paper in the framework of the model under study it is possible for a company to choose a foreign supplier and the amount of purchase taking into account the time value of money. This enables the company reduce stock and thus, reduce the amount of money frozen in stock and enhance the efficiency of international trade.

The paper also shows that in the conditions of uncertainty may choose a solution criterion in order to optimize the purchase model under the import contracts. These criteria may include the criterion of Wald, Hurwitz, Savage, maximax, neutral. Thus, the company expresses its attitude to admissible losses of the ultimate economic result when selecting the best solution.

Generally speaking, the developed methodology for choosing the optimal purchase amount under the import contract represents a methodological toolware for efficiency enhancement of international trade, which is attained as a combination of a number of factors, which should be taken into consideration

when making adequate managerial decisions under economic uncertainty. These also include the purchase price of the import good, its selling price, supply costs, losses arising from quality claims, as well as due to the strategy of supply diversification by choosing foreign suppliers.

We believe that the advantage of methodology is its universal character, as it can be used when searching an optimal value of any parameter of an international contract under economic uncertainty.

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