METHODICAL APPROACH TO COMPLEX INVESTMENT ANALYSIS OF CASH FLOWS ON THE EXAMPLE OF THE FLEET REPLENISHMENT PROJECT

МЕТОДИЧНІ ЗАСАДИ КОМПЛЕКСНОГО ІНВЕСТИЦІЙНОГО АНАЛІЗУ ГРОШОВИХ ПОТОКІВ НА ПРИКЛАДІ ПРОЄКТУ ПОПОВНЕННЯ ФЛОТУ

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The purpose of the article is to develop a methodical approach to complex investment analysis of cash flows on the example of shipping investment. This is especially relevant for projects in the shipping industry with a significant capital costs, a high share of debt financing, a low profitability and a high risk. The study used such scientific methods as financial modelling, analysis and synthesis of results, logic and analytical methods. Authors have developed the approach to investment analysis of cash flows for the shipbuilding project, which includes five stages. At the first stage the structure of investment are determined, taking into account ship type and size and building terms. The second stage involves construction the three statements model for forecasting of financial indicators. At the third stage assessment of profitability and liquidity were fulfilled. At the fourth stage security cover ratios and average breakeven were analysed. The fifth stage is devoted to risk assessment with using techniques of sensitivity and scenario analysis.

Keywords: financial results, investment analysis, investment project, cash flow, shipping company, fleet, risks, sensitivity analysis, scenario analysis.

Метою статті є розробка методичного підходу до комплексного інвестиційного аналізу грошових потоків на прикладі проєкту поповнення флоту. Це особливо актуально для інвестиційних проєктів у судноплавній галузі, які характеризуються високими капітальними витратами, високою часткою боргового фінансування, відносно низьким рівнем прибутковості й підвищеним рівнем ризику, пов'язаного з волатильністю цін на морські перевезення. У дослідженні використані такі наукові методи як фінансове моделювання, логіко-аналітичний метод, аналіз і синтез отриманих результатів. Авторами запропоновано методичний підхід до інвестиційного аналізу, що складається з п'яти етапів. На першому етапі визначається структура інвестицій з урахуванням типу та розміру судна, умов будівництва, співвідношення позикового і власного капіталу тощо. Другий етап передбачає побудову фінансової моделі для прогнозування фінансових результатів, показників балансу та руху грошових коштів. З урахуванням схеми фрахтування судна, прогнозу кон'юнктури фрахтового ринку, експлуатаційного періоду, частоти та вартості докового ремонту, здійснюється прогноз операційних доходів і витрат на основі припущення щодо зміни добових операційних витрат судновласника, фінансових результатів, показників рентабельності та ефективності, горизонтальний аналіз прогнозних фінансових результатів і впливу драйверів на рентабельність. Наступний крок передбачає прогнозування показників балансу і грошових потоків, а також аналіз грошових потоків з урахуванням прогнозного рівня фрахтових ставок. На третьому етапі проводиться оцінка рентабельності та ліквідності проєкту з урахуванням прогнозної залишкової вартості судна наприкінці терміну реалізації проєкту, прогнозу вільного грошового потоку на власний капітал та вартості капіталу. На четвертому етапі аналізуються коефіцієнти покриття боргу, середній беззбитковий рівень тайм-чартерного еквівалента, щорічне співвідношення боргу і залишкової вартості судна,

можливість покриття витрат на погашення кредиту з EBITDA. П'ятий етап присвячений оцінці ризиків із застосуванням методів аналізу чутливості та сценарного аналізу. Практична цінність дослідження полягає в тому, що використання розроблених методичних засад інвестиційного аналізу, які враховують специфіку діяльності судноплавних компаній, дозволять уникнути збитків і покращити результати реалізації проєктів поповнення флоту.

Ключові слова: фінансові результати, інвестиційний аналіз, інвестиційний проєкт, грошовий потік, судноплавна компанія, флот, ризики, аналіз чутливості, сценарний аналіз.

Formulation of the problem. Taking into account the capital intensity of investment projects of fleet replenishment and the high level of risk associated with the volatility of the freight market, the problem of a thorough comprehensive analysis of investment projects is important to ensure the financial and economic security of shipping companies. Therefore, an important task is to develop methodical approach to determining and maximizing the real projected return on investment from the point of view of a shipping company and financial institutes crediting the shipping industry.

Analysis of recent research and publications. In the book by Damodaran [1] the methodological and methodical approaches for investment valuation and formation of investment portfolio were considered. In the article of Bartram et al. [2, p. 804] is considered importance of financial risk and operating and asset characteristics as the most important determinants of this risk. In the book by Donets economical risks and methods of their measurement are investigated [3, p. 45]. In the work of Zavoronkov et al. [4] general approaches to management of investments and innovations were considered. In the book by Marchenko et al. the indicators of the analysis of the financial status of the enterprise and the approach to the analysis of profitability were examined [5, p. 80]. Stopford examined the formation of cash flows in shipping and financial aspects of vessels operation [6, p. 152]. The paper of Kelly et al. is an application of decision model for asset management of a vehicle fleet [7, p. 682]. In the work by Bazaluk et al. the quantitative approach for determining the investment portfolio of a shipping company taking into account the equity value is proposed [8, p. 5]. In the monograph by Zhykharieva et al. methods of financing investment in shipping industry and approached to investment planning were researched [9, p. 247]. In the article by Cullinane [10] a shipowner's financial commitments as investments is considered. The authors investigated development of a hedging strategy in shipping can be treated as a portfolio optimization problem.

Selection of previously unsolved parts of the problem. According to the analysis of sources, scientists consider different methods of investment profitability assessment, financing and approaches to minimization of financial risks. But there is no complex methodical approach to investment analysis of cash flows taking into account specific features of shipping projects.

Formulation the goals of the paper. The paper develops a complex methodical approach to investment analysis of cash flows taking into consideration specifics of fleet replenishment project.

Presentation of the main research material. The following scheme of a complex investment analysis of forecast cash flows related to the fleet replenishment project is proposed (Table 1).

At the first stage, the value and structure of investments are determined. Taking into account the commercial philosophy of the shipping company, type and size of the vessel and main operational characteristics are selected. Next, the shipowner should choose a shipyard, estimate the building value of the vessel and determine the building period from the signing of the shipbuilding contract to delivery of a vessel. Considering the building value of a vessel and the specified loan to value ratio (LTV), the amounts of debt and equity financing for the investment project are determined. Payments before ship delivery are usually made at the shipowner's own expense and include the following payments: signing of the shipbuilding contract; steel cutting; keel laying; launching. The rest of value is paid using a bank loan after ship's delivery.

At the second stage, a forecast of financial indicators is carried out using the 3 statement financial model. To determine the operational revenue, the vessel chartering scheme (voyage charter, time or bareboat charter) is selected. Next, a forecast of the freight market condition is carried out. Depending on the type of chartering, voyage freight rates for transporting a unit of cargo or daily time (bareboat) charter rates are estimated.

Table 1

**Scheme of comprehensive investment analysis of cash flows related
to the fleet replenishment project**

STAGE 1. DETERMINATION OF AMOUNT AND STRUCTURE OF INVESTMENT	
1.1	Choice of type and size of a vessel, the main technical and operational characteristics
1.2	Choice of a shipyard
1.3	Estimation of the projected building value of a vessel and amount of investment
1.4	Determination of estimated term of building
1.5	Determination loan to value ratio (LTV)
1.6	Forecast of the structure of pre-delivery financing
1.7	Choosing a loan scheme and drawing up a loan repayment schedule
STAGE 2. FORECAST OF FINANCE INDICATORS	
2.1	Choice of chartering scheme
2.2	Forecast of freight market condition for period of investment project
2.3	Forecast of operational period, frequency and time of dock repair
2.4	Forecast of operational revenue for period of investment project
2.5	Forecast of operational expenses (OPEX) based on an assumption regarding the change in shipowner's daily OPEX
2.6	Forecast of financial results
2.7	Forecast of profitability and efficiency
2.8	Horizontal analysis of forecasted financial results
2.9	Factor analysis of profitability
2.10	Forecast of balance sheet indicators
2.11	Forecast of cash flows under consensus scenario
2.12	Analysis of annual cash flows taking into account forecast level of freight rates
STAGE 3. ASSESSMENT OF RETURN ON INVESTMENT	
3.1	Forecast of residual value of vessel at the end of investment project
3.2	Forecast of free cash flow to equity (FCFE)
3.3	Forecast of the cost of capital
3.4	Calculation of NPV, IRR, ROI and other indicators using project future cash flows
3.5	Calculation of payback period by different methods
3.6	Assessment of profitability and liquidity of investment project, economic effect and payback period
STAGE 4. ANALYSIS OF DEBT COVER IN EACH PERIOD	
4.1	Calculation of debt service cover ratio, analysis of debt service cost cover from EBITDA in each period of credit amortization
4.2	Assessment of time charter equivalent (TCE) daily breakeven and average breakeven during period of credit amortization. Comparison of average breakeven with TCE at the beginning of firth year of operation (or with historical TCE in recent years)
4.3	Calculation of LTV in each period of investment project. Analysis of LTV
STAGE 5. RISK ASSESSMENT	
5.1	Qualitative risk assessment of the investment project, determination of the main parameters affecting profitability indicators
5.2	Quantitative assessment of risk
5.2.1	Sensitivity analysis
5.2.2	Scenario analysis
5.2.3	Calculation of investment project risk indicators
5.3	Conclusions regarding the level of risk of the investment project

Source: developed by the authors

Further, based on the forecast of the operational period, the frequency and time of dock repairs and the forecast of freight rates, revenue from vessel operation (freight) is projected. One of the ways of forecasting freight is calculation based on daily TCE.

OPEX are projected based on the assumption of changes in direct daily OPEX of shipowner, forecast operational period, indirect operating cost and amount of tax depreciation. As the cost of dock repairs increases the book value of a vessel, dock repair costs are also amortized over the period (e.g. 4 years if dock repairs are carried out every 4 years). Next, the book value of a vessel at the end of each year is calculated taking into account dock repairs.

In the next step, gross profit, operating profit (EBIT), EBITDA and net income are calculated considering the cost of debt financing and income tax in annual terms. Such indicators of profitability and efficiency as EBITDA margin, gross profit margin, net profit margin, tax ratio, operating costs / revenue ratio and property, plant and equipment (PP&E) turnover ratio are calculated. The analysis of factors that affect the net profit margin involves consideration of such drivers as tax impact, capital structure impact and EBIT margin. At the next step, a horizontal analysis of forecasted financial results is made, the trend of changes in financial results is determined, for example, gradual growth, smooth decline, exponential growth, sharp decline, significant volatility, etc.

The forecast of the balance sheet indicators from the first year of investment project is initially carried out without cash, which will be calculated later. The forecast of inventory can be carried out on the basis of forecast inventory days and cost of sales, i.e. direct operating cost without depreciation. The forecast of accounts receivable by year can be made on the basis of accounts receivable days and operational revenue. The forecast of accounts payable is based on the forecast accounts payable days and direct operating costs without depreciation [11].

Next, the annual cash flows related to operating, investment and financial activities for the period of investment project are calculated. Cash flow from operating activities is calculated using the indirect method based on net income, non-cash expenses and changes in working capital. Changes in working capital are calculated based on forecast balance sheet data as follows [11]:

+ (increase) / decrease in inventory;

+ (increase) / decrease in receivables;

+ increase / (decrease) in payables.

Changes in inventory, receivables and payables are calculated as the difference between the corresponding balance sheet figures in the current year and the previous year. Next, the forecast balance sheet is supplemented with cash at the end of the corresponding year, and a check is made (total assets – liabilities and equity = 0). In the next step, annual net cash flow is analysed taking into account the forecast level of freight rates for the period of investment project.

At the third stage, the investment return is assessed taking into consideration the time value of money: NPV, IRR, ROI and other indicators are calculated based on the project's future cash flows. The future cash flow of the last year includes the estimated residual market value of vessel. The projected market resale value of vessel at the end of the project period should be predicted taking into account physical depreciation over the entire period of operation. For example, the project implementation period is 8 years. At the end of the 7th year of the vessel's operation, physical depreciation (without considering the forecast change in TCE) is 7/20 = 35% of the vessel's value, i.e. the residual value of a vessel at the end of the 8th year of the project period (or the 7th year of operation) is 65% of the building value. It is advisable also to take into account the forecast change in TCE.

If cash flows are discounted after paying interest and principal, then we are talking about free cash flow to equity, and the cost of equity can be used as a capitalization rate. Next, the internal rate of return (IRR), the investment payback period (PBP) and the discounted payback period (DPP) are determined, and analysed the level of profitability and liquidity of the investment project and the economic effect.

At the fourth stage, the ability to cover expenses in each period is analysed. The debt service cover ratio (DSCR) is calculated as the ratio of operating cash flow to the amount of debt repayment expenses [12, p. 93]. The possibility of covering loan repayment costs with EBITDA in each year during the loan repayment period is analysed. If the shipowner does not intend to attract additional cash to finance the project, then an acceptable option for shipowner, should satisfy the condition that the net cash flow in each period is not negative.

Breakeven comparison in each period involves comparing the amount of cash OPEX and loan payments (including interest) with the level of the expected average annual time

charter freight in the corresponding periods. Next, the TCE daily breakeven is determined on the basis of total costs and the operating period, and the average breakeven during the loan repayment period is calculated [12, p. 93]. The level of average breakeven is compared with the TCE at the beginning of the first year of operation (or with the historical TCE for recent years).

Loan to value (LTV) comparison provides an estimate of the possibility of covering the loan debt by selling the vessel. The LTV is calculated as the ratio between the debt at the end of each year and the residual value of vessel at the end of the year in percentage [12, p. 93]. This indicator shows the ratio between current debt and the value of the asset (vessel).

The security cover or current ratio is calculated as the ratio between the estimated residual value of vessel at the end of the corresponding year to the balance of the debt as a percentage [12, p. 94]. This ratio shows the level of short-term liquidity, whether the company will be able to cover its obligations in the short term. The analysis of the ratio in each year gives an estimate of the possibility of covering the loan by selling the vessel in a pessimistic scenario of changes in freight rates. This is important for both

the bank and the borrower. At the same time it is necessary to take into account the relationship between the level of freight rates and the market value of second-hand vessels.

Methodical approach to investment analysis illustrated on the example of a shipping company which plans an investment project of building the Panamax bulk carrier using equity and debt financing. Table 2 shows the calculations of security ratios in Excel.

At the fifth stage, a qualitative and quantitative risk assessment of the investment project is performed. Such indicators as freight rates, direct operating costs, capitalization rate, operating revenue, EBITDA, interest rate, residual value of the vessel at the end of the project period, etc. can be considered as parameters that affect the profitability of the project. To determine the key parameter or several key parameters of the investment project, sensitivity analysis of the project should be carried out according to the factors that affect the profitability of the investment project (Table 3). Next, the rating of the project parameters, which are checked for risk, is determined. Those parameters that lead to the largest NPV deviations are selected as key parameters. Sensitivity analysis and identifying

Table 2

Security ratios for the investment project

Years	2024	2025	2026	2027	…
TCE, USD/day	13200	13200	13200	13200	
Експлуатаційний період	360	360	360	340	
Revenue, USD	4752000	4752000	4752000	4488000	
Cash OPEX, USD	2065000	2083250	2106783	2295299	
EBITDA, USD	2687000	2668750	2645217	2367701	
Interest, USD	323750	253750	183750	113750	
Repayment, USD	1000000	1000000	1000000	1000000	
Debt Service Cover Ratio	**2,03**	**2,13**	**2,23**	**2,13**	
Debt service, USD	1323750	1253750	1183750	1113750	
Cash OPEX, USD	2065000	2083250	2106783	2295299	
Total expenses, USD	3388750	3337000	3290533	3409049	
Daily Breakeven, USD/day	9413	9269	9140	10027	…
Average Breakeven, USD/day	**9435**				
Residual value of vessel at the beginning of the year, USD	10000000	9500000	9000000	8500000	
Balance of debt at the beginning of the year, USD	5000000	4000000	3000000	2000000	
LTV (Loan / Vessel value), %	**50**	**42**	**33**	**24**	
Security Cover, %	**200**	**238**	**300**	**425**	

Source: calculated by the authors

the most «bottlenecks» allows to adjust the project and to choose the safest strategy that will avoid significant losses due to changes in the external environment.

In the next step, the scenario analysis can be used to calculate the indicators of the quantitative assessment of the risk level. The factor that has the greatest impact on the economic effect is selected as the key parameter of the project. As a rule, the level of freight rates (or TCE) is chosen as such key parameter. At the same time, it is taken into account that the level of the interest rate and the terminal resale value of the vessel depend on the freight market condition. Scenarios of changes in project parameters (for example, TCE, daily OPEX and interest rate) by years and the probability of each scenario are determined on the basis of expert assessments. At least three scenarios are considered – consensus case, bull case and bear case. For all scenarios, the NPV is determined based on the financial model in Excel using the scenario selector. The probability of each scenario is determined on the basis of expert assessments method. Next, the indicators that characterize the level of risk of the investment project

are calculated: the probability of receiving a negative NPV, the expected NPV, the sample standard deviation, variation and the total risk for NPV as a deviation of the expected NPV from the NPV under consensus scenario (Table 4).

The probability of positive NPV cannot be an adequate measure of risk, since the shipping company plans to obtain not just a positive NPV, but NPV that provides an acceptable level of profitability. From the point of view of financial management, the level of risk of an investment project may be defined as the deviation of the project's cash flows from their expected value. The expected NPV can be taken as a mathematical expectation or an effective value from the point of view of the shipping company, calculated on the basis of the consensus scenario (for example, at a certain level of the profitability index). If the NPV is negative for all scenarios, the project is definitely rejected. If the NPV is negative only for pessimistic scenarios, the decision to reject or accept the project should be made by the company's management based on the analysis of the indicators that characterize the level of risk, taking into account the financial

Table 3

Sensitivity analysis of the project

Change of TCE, %	0%	10%	20%	-10%	-20%	-25%
NPV, USD	3683350	4160162	5272724	3365476	3047601	2888664
IRR, %	23,1%	25,4%	31,5%	21,7%	20,4%	19,7%
DPP, years	7,08	6,97	6,69	7,16	7,24	7,28
Change of daily OPEX, %	**0%**	**10%**	**20%**	**-10%**	**-20%**	**-25%**
NPV, USD	3683350	2673216	316235	4356774	5030197	5366908
IRR, %	23,1%	19,6%	11,3%	25,5%	27,9%	29,1%
DPP, years	7,08	7,32	7,91	6,94	6,79	6,72
Change of interest, %	**0%**	**10%**	**20%**	**-10%**	**-20%**	**-25%**
NPV, USD	3683350	3413997	2816250	3867516	4055458	4150873
IRR, %	23,1%	22,8%	22,0%	23,4%	23,6%	23,7%
DPP, years	7,08	7,12	7,22	7,06	7,03	7,02
Change of NPV, %	**0%**	**10%**	20%	-10%	-20%	-25%
TCE	0,0%	12,9%	43,2%	-8,6%	-17,3%	-21,6%
Daily OPEX	0,0%	-30,2%	-202,5%	16,8%	28,7%	33,5%
Interest	0,0%	-7,3%	-23,5%	5,0%	10,1%	12,7%
Rating of risk parameters	+10% Δ	-10% Δ	ABC	Elasticity of NPV		Rating
TCE	12,9%	-8,6%	12,9%	1,29%		1
Interest	-7,3%	5,0%	7,3%	0,73%		2
Daily OPEX	-30,2%	16,8%	30,2%	3,02%		3

Source: calculated by the authors

Table 4

Scenario analysis of the investment project

Years	2024	2025	2026	2027	…
Consensus	TCE	13 200	13 200	13 200	
	Daily OPEX	5 000	5 050	5 101	
	Interest rate	7%			
Bull case	TCE	13 500	13 600	13 700	
	Daily OPEX	4 600	4 646	4 692	
	Interest rate	6%			
Bear case	TCE	12 300	12 200	12 100	
	Daily OPEX	6 000	6 060	6 121	
	Interest rate	8%			
Live case	TCE	13 200	13 200	13 200	
	Daily OPEX	5 000	5 050	5 101	
	Interest rate	7%			
		Bull case	Consensus	Bear case	
Scenario probability		0,15	0,6	0,25	
NPV, USD		5128670	3683350	808702	
Risk indicators					
Risk of negative NPV, %		0			
Average NPV, USD		3181486			
Sample standard deviation S_{NPV}, USD		2199261			
Variation, CV_{NPV}		0,69			
Total risk by NPV, USD		(501 864)			

Source: calculated by the authors

condition, the ability and desire to cover negative cash flows in certain periods with equity.

The coefficient of variation is a relative indicator that characterizes the ratio of profitability and risk. The coefficient of variation makes it possible to compare the results of different projects that are not comparable in absolute terms, for example, with different scale of investments and different terms of project implementation. Among several alternative projects, the project with the lowest coefficient of variation has the best ratio of risk and profitability.

Conclusions. Proposed methodical approach to complex investment analyses includes five successive stages. Completing the tasks of the first stage allows to determine the value and structure of investments, taking into consideration the type and size of a ship, the choice of a shipyard, the estimation of the value and term of building, the ratio of debt and equity, the structure of financing before the delivery of a ship and the loan repayment scheme. The second stage involves the construction of a financial model for forecasting financial results based on a certain scheme of chartering, forecast of the freight market situation, duration of operational period, frequency and time of dock repairs, forecast of balance sheet indicators and cash flows. This stage also provides estimation of profitability and efficiency, a horizontal analysis of forecasted financial results and analysis of the impact of factors on profitability. The analysis of annual cash flows is carried out taking into account the forecast level of freight rates.

At the third stage, the profitability and liquidity of the project is evaluated, considering the projected residual value of the vessel at the end of the project's implementation period, the forecast of free cash flow on equity and the cost of capital. At the fourth stage such factors as debt coverage ratios, the average breakeven level of the TCE, the annual ratio of the debt to the residual value of a vessel, the possibility of covering the loan repayment with EBITDA in each year of the loan period were analysed. The fifth stage is devoted to quantitative and qualitative

assessment of risks using methods of sensitivity and scenario analysis. Scenarios can take into account changes in freight rates, interest rates, operating costs and other project parameters. The main criterion for the effectiveness of an investment project is acceptable ratio between profitability and risk.

Methodical approach to the comprehensive investment analysis, which take into account the specific features of shipbuilding projects, operational, investment and financial activities of shipping companies, allow to improve the ratio of profitability and risk for investment projects for the purchase of marine vessels.

REFERENCES:

1. Damodaran, A. (2012) *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset.* John Wiley & Sons Inc.: New York.

2. Bartram, S., Brown, G., & Waller, W. (2015) How Important Is Financial Risk? *Journal of Financial and Quantitative Analysis.* 50(4). 801-824. DOI: https://doi.org/10.1017/S0022109015000216.

3. Donets, L. I. (2006) *Ekonomichni ryzyky ta metody yikh vymiriuvannia* [Economic risks and methods of their measurement]. Kyiv: Tsentr navchalnoi literatury. (in Ukrainian)

4. Zhavoronkov, H. V., Sivashenko, T. V., Skibitska, L. I., & Tuz O. I. (2018) *Upravlinnia investytsiiamy ta innovatsiiamy* [Management of investments and innovations]. Kyiv: Kondor. (in Ukrainian)

5. Marchenko, M. M., Shyriaieva, L. V., & Oneshko, S. V. (2017) *Analiz finansovoi zvitnosti pidpryiemstva* [Analysis of financial statements]. Odesa: Interprint. *(*in Ukrainian)

6. Stopford, M. (2009) *Maritime Economics*. New York: Routledge.

7. Kelly, D., Lupa, M., Paz de Araujo, M., & Casper, C. (2014) Asset Management of Vehicles: A Practical Application of the Logic Scoring of Preference Method of Optimizing Programmatic Investment Decisions in a Performance based System. *Procedia Computer Science.* DOI: https://doi.org/10.1016/j.procs.2014.05.477.

8. Bazaluk, O., Zhykharieva, V., Vlasenko, O., Nitsenko, V., Streimikiene, D., & Balezentis, T. (2022) Optimization of the Equity in Formation of Investment Portfolio of a Shipping Company. *Mathematics.* 10. 363. DOI: https://doi.org/10.3390/math10030363.

9. Zhykharieva, V. V., Vlasenko, O. S., Bundiuk, R. A., & Sokolova M. S. (2022) *Ekonomika sudnoplavstva i servisnoi diialnosti: hlobalni trendy y transformatsiia* [Economics of shipping and service activities: global trends and transformation]. Odessa: ONMU. Retrieved from: https://issuu.com/vlasenkoolga/docs/monog_economics_shipping [in Ukrainian].

10. Cullinane, K. (1995) A portfolio analysis of market investments in dry bulk shipping. *Transportation Research.* Vol. 29. Issue 3. DOI: https://doi.org/10.1016/0191-2615(94)00032-U.

11. Financial Analysis Fundamentals (2021) Corporate Finance Institute. Retrieved from: https://corporatefinanceinstitute.com/course/financial-analysis-fundamentals/

12. Norton, S. Shipping Finance (2021). Institute of Chartered Shipbrokers, UK – ICS.

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ:

1. Damodaran A. *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*. John Wiley & Sons Inc. : New York, 2012.

2. Bartram, S. Brown, G., Waller W. How Important Is Financial Risk? *Journal of Financial and Quantitative Analysis.* 2015. No. 50(4). P. 801–824. DOI: https://doi.org/10.1017/S0022109015000216.

3. Донець Л. І. *Економічні ризики та методи їх вимірювання*. Київ : Центр навчальної літератури. 2006.

4. Жаворонков Г. В, Сівашенко Т. В., Скібіцька Л. І., Туз О. І. *Управління інвестиціями та інноваціями*. Київ : Кондор, 2018.

5. Марченко М. М., Ширяєва Л.В., Онешко С.В. *Аналіз фінансової звітності підприємства*. Одеса : Інтерпрінт, 2017.

6. Stopford M. *Maritime Economics*. New York : Routledge, 2009.

7. Kelly D., Lupa M., Paz de Araujo M., Casper C. Asset Management of Vehicles: A Practical Application of the Logic Scoring of Preference Method of Optimizing Programmatic Investment Decisions in a Performance based System. *Procedia Computer Science.* 2014. DOI: https://doi.org/10.1016/j.procs.2014.05.477.

8. Bazaluk O., Zhykharieva V., Vlasenko O., Nitsenko V., Streimikiene D., Balezentis T. Optimization of the Equity in Formation of Investment Portfolio of a Shipping Company. *Mathematics*. 2022. No. 10. P. 363. DOI: https://doi.org/10.3390/math10030363.

9. Жихарєва В. В., Власенко О. С., Бундюк Р. А., Соколов М. С. *Економіка судноплавства і сервісної діяльності: глобальні тренди й трансформація*. Одеса : ОНМУ. 2022. URL: https://issuu.com/vlasenkoolga/docs/monog_economics_shipping.

10. Cullinane K. A portfolio analysis of market investments in dry bulk shipping. *Transportation Research.* 1995. Vol. 29. Issue 3. DOI: https://doi.org/10.1016/0191-2615(94)00032-U.

11. Financial Analysis Fundamentals. Corporate Finance Institute. 2021. URL: https://corporatefinanceinstitute.com/course/financial-analysis-fundamentals.

12. Norton, S. Shipping Finance (2021) Institute of Chartered Shipbrokers, UK – ICS.