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FINANCIAL RISK ASSESSMENT BASED ON A DYNAMIC MODEL: A CASE OF SHIPPING INVESTMENTS

Summary. Given the high uncertainty of the external business environment, risk assessment is of particular importance for companies operating in capital-intensive and high-risk sectors such as the shipping industry. This paper proposes a novel methodical approach to financial risk assessment that integrates several complementary methods. The approach is grounded in the development of a fully dynamic financial model that enables the calculation of projected financial indicators and the evaluation of risk through scenario analysis and descriptive statistical methods. The approach is examined using a case study of a newbuilding project for a dry bulk vessel. Based on the financial model and key project drivers, a set of scenarios is constructed, and statistical indicators are derived to quantify the financial risks associated with the volatility of freight rates, operational expenditure levels, and investment financing conditions relevant to shipping companies.

1. INTRODUCTION

Investment planning and cash flow forecasting are critical for ensuring the financial and economic sustainability of transport companies. A core component of investment analysis is financial risk assessment, which facilitates the identification of cash flow volatility, deviations in economic outcomes from expected values, the development of alternative scenarios for key project drivers, and the estimation of potential losses to support the formulation of effective risk management strategies.

In the shipping industry, the risks affecting company performance can generally be classified as either systematic or unsystematic. Systematic risks stem from external factors in the business environment and include economic, political, legal, and force majeure risks. In contrast, unsystematic risks originate within the organization and encompass technological, organizational, and managerial uncertainties. These risks can be assessed using various quantitative methods, commonly involving descriptive statistical techniques. Quantifying both types of risk is essential for the development of robust risk mitigation strategies.

These considerations highlight the relevance of the present study, which proposes a methodical approach to assessing financial risk for infrastructure investment projects based on the development of a fully dynamic financial model, illustrated through the example of a shipping investment.

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2. LITERATURE REVIEW

Theoretical and practical aspects of risk analysis have been explored by numerous scholars. In [1], operating and asset characteristics are identified as important determinants of financial risk. Meanwhile, [2] outlines major categories of financial risk faced by companies, including market risk, credit risk, liquidity risk, and operational risk.

Methodological approaches to risk management in the shipping industry are addressed in works such as [3-5]. In [3], the importance of risk assessment and mitigation measures for the survival and development of shipping companies is emphasized. According to [4], the success of risk analysis depends on whether the appropriate method or combination of methods is selected through a critical evaluation of available data. The study [5] defines risk evaluation as the process of estimating how future events may influence corporate management.

A quantitative approach to determining the investment portfolio of a shipping company, incorporating equity value through mathematical programming, is developed in [6], while [7] proposes the logic scoring of preference methodology as a second-order decision model for public agency vehicle fleet management.

In the foundational book on maritime economics [8], various types of chartering and the formation of cash flows in shipping companies are considered. The study [9] investigates methods of financing shipping investments through equity and debt, highlighting their impact on financial risk. A portfolio analysis of market investments in the dry bulk sector is conducted in [10].

Investment valuation tools and methods based on cash flow forecasting are examined in [11]. The methodological approach of the Corporate Finance Institute to constructing a three-statement financial model using Microsoft Excel is outlined in [12]. A comprehensive scheme for investment analysis, including investment structure definition, financial indicator forecasting, return assessment, debt coverage analysis, and risk evaluation, is presented in [13].

Despite the considerable number of studies on shipping industry risk management, the field still lacks a unified scientific approach. In particular, further research is required to advance methodical frameworks for the quantitative assessment of financial risks in shipping investments.

3. AIMS

The primary objective of this study is to develop a methodological approach for financial risk assessment in transport infrastructure projects, with a specific focus on shipping investments. This approach integrates a dynamic financial forecasting model based on the three core financial statements and incorporates scenario analysis. Furthermore, the present study aims to process and interpret the resulting forecasts using descriptive statistical methods.

4. METHODS

The method of this study is grounded in scholarly literature in the fields of financial management, investment valuation, risk management, maritime economics, and shipping finance. Risk assessment represents a critical component of the investment analysis for shipbuilding projects. One of the primary challenges in this process is accurately forecasting expected financial indicators. The current study addresses this challenge by employing a three-statement model that integrates the income statement, balance sheet, and cash flow statement into a fully dynamic framework. This model facilitates both the projection of future financial outcomes and the estimation of associated risk levels.

While financial analysts typically use three-statement models to forecast company performance based on historical data, this study adapts the model for a standalone shipbuilding investment project. The model was constructed based on a set of assumptions, including freight market conditions, operational expenditure levels, project implementation timeline, dry dock repair intervals, financing terms, and cost of capital. The main stages of constructing the three-statement model for this application are illustrated in Fig. 1.

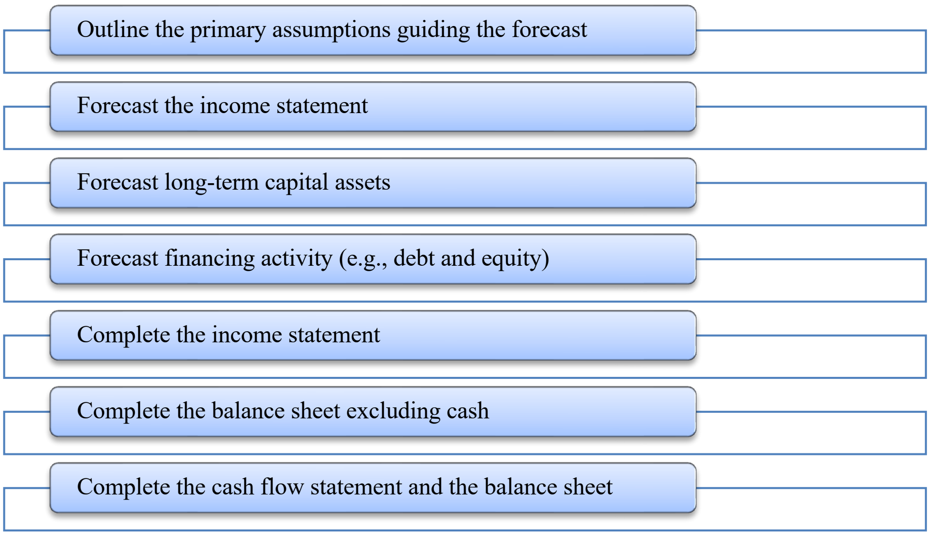

Fig. 1. Key stages in the construction of a three-statement model

From a financial management perspective, the risk level of an investment project is defined as the variability of the project's cash flows relative to their expected value [13]. The greater the variability of cash flows, the higher the financial risk associated with the project. In other words, investment project risk arises from uncertainty caused by the influence of various systematic and unsystematic risk factors.

This study employs a combination of theoretical and empirical research methods, including logical and analytical reasoning, analysis and synthesis of results, scenario analysis, the development of a three-statement financial model, and descriptive statistical techniques.

5. GENERALIZATION OF THE MAIN STATEMENTS AND DISCUSSION

5.1. Investment value and structure

Determining the investment value and its structure requires the following components:

- Selection of the vessel's key technical and operational characteristics, identification of an appropriate shipyard, and estimation of design costs and construction duration.
- Definition of the debt financing share and the structure of equity financing.
- Selection of a loan scheme and development of a loan repayment schedule.

The proposed methodological approach is illustrated using a case study of an investment project for the construction of a Panamax-class bulk carrier intended for the transportation of dry cargo, with a deadweight of 65,000 tons. The construction period is planned to last for one year, from the end of 2025 to the end of 2026, while the overall investment project implementation period spans eight years, from the end of 2025 to the end of 2033. The loan repayment period is set at five years, with an annual interest rate of 7%. The debt-to-equity ratio and the payment structure to the shipyard prior to vessel delivery are presented in Table 1.

The loan-to-value ratio, which, in this case, equals the share of debt financing (70%), is a critical determinant in investment projects involving borrowed capital. It directly influences the degree of financial leverage and plays a significant role in shaping a project's financial risk profile.

Table 1

Structure of investment financing and payments to the shipyard

Financing structure	**2025**	**2026**
Cost of ship construction, USD	20,000,000	
Share of debt financing, %	70	
Share of equity financing, %	30	
Debt, USD	14,000,000	
Equity, USD	6,000,000	
Debt to equity ratio	2.3	
Payments to the shipyard before delivery of the vessel		
Signing the new building ship contract, USD	2,000,000	
Steel cutting, USD		1,000,000
Lay the keel, USD		2,000,000
Launch from slipway and sea trials, USD		1,000,000

5.2. Forecasting financial indicators

Financial indicators are forecast using a three-statement financial model including the following components:

- Selection of the vessel's chartering scheme, such as voyage charter, time charter, or bareboat charter.
- Assumptions regarding market freight rates for dry bulk cargo transportation.
- Projection of operating revenue and operating expenditures (OPEX).
- Forecast of income statement figures and analysis of expected profitability and operational efficiency.
- Forecast of balance sheet indicators.
- Forecast and analysis of cash flows.

A fragment of the forecasted income statement for the first four years of the operational period (2027–2033) generated from the Microsoft Excel-based financial model is presented in Table 2.

The forecasted balance sheet indicators are presented in Table 3. Inventory forecasts by year can be performed based on inventory turnover in days and direct operating costs excluding depreciation. Annual projections of accounts receivable may be based on receivables turnover and operating revenue. Likewise, accounts payable forecasts can be carried out using accounts payable turnover and direct OPEX excluding depreciation.

Cash flow from operating activities is projected using the indirect method, which is based on net income adjusted for depreciation and net changes in working capital. Forecasted cash flows incorporate net financial results, depreciation, amortization, and other non-cash items from the income statement, while the net change in operating working capital is derived from balance sheet data. In addition to depreciation, other cash flow adjustments may include non-cash expenses such as stock-based compensation, unrealized gains, and unrealized losses.

An alternative formula for calculating the net change in working capital includes changes in inventories, accounts receivable, and accounts payable [12]:

$$NCWC = \Delta\, Inventories + \Delta\, Receivables + \Delta\, Payables. \quad (1)$$

Changes in working capital were calculated based on forecast balance sheet data as follows:

- (increase) / decrease in inventories;
- + (increase) / decrease in receivables;
- + increase / (decrease) in payables.

Table 2

Selected forecasted financial results (consensus scenario), USD

	2027	2028	2029	2030	…
Revenue	**6,120,000**	**6,084,000**	**6,012,000**	**5,692,500**	…
Direct OPEX excluding depreciation	1,825,000	1,834,125	1,848,346	1,852,512	…
Ship value depreciation	2,000,000	1,800,000	1,620,000	1,458,000	…
Dock repair value depreciation	-	-	-	225,000	…
Direct OPEX including depreciation	3,825,000	3,634,125	3,468,346,	3,535,512	…
Gross profit	**2,295,000**	**2,449,875**	**2,543,654**	**2,156,988**	…
Indirect OPEX	260,000	260,000	260,000	260,000	…
Earnings before interest, taxes, depreciation and amortization (EBITDA)	4,035,000	3,989,875	3,903,654	3,579,988	…
Earnings before interest and taxes (EBIT)	**2,035,000**	**2,189,875**	**2,283,654**	**1,896,988**	…
Cost of debt financing	647,500	507,500	367,500	227,500	…
Pre-tax income	1,387,500	1,682,375	1,916,154	1,669,488	…
Income tax	249,750	302,828	344,908	300,508	…
Net income	**1,137,750**	**1,379,548**	**1,571,246**	**1,368,980**	…

Table 3

Selected forecasted balance sheet indicators (consensus scenario), USD

	2025	2026	2027	2028	…
ASSETS					
Cash	4,500,000	500,000	306,202	688,931	…
Accounts receivable	-	-	536,548	533,392	…
Inventory	-	-	150,000	150,750	…
Current assets	*4,500,000*	*500,000*	*992,750*	*1,373,073*	...
Investments	2,000,000	-	-	-	…
Property, plant, and equipment	-	20,000,000	18,000,000	16,200,000	…
Total assets	**6,500,000**	**20,500,000**	**18,992,750**	**17,573,073**	…
LIABILITIES					
Short term debt	-	-	-	-	…
Accounts payable	-	-	155,000	155,775	…
Current liabilities	-	-	*155,000*	*155,775*	…
Long term debt	-	14,000,000	11,200,000	8,400,000	…
Total liabilities	-	*14,000,000*	*11,355,000*	*8,555,775*	…
EQUITY					
Equity capital	6,500,000	6,500,000	6,500,000	6,500,000	…
Retained earnings	-	-	1,137,750	2,517,298	…
Shareholder's equity	*6,500,000*	*6,500,000*	*7,637,750*	*9,017,298*	…
Liabilities & Equity	**6,500,000**	**20,500,000**	**18,992,750**	**17,573,073**	…

Changes in inventories, accounts receivable, and accounts payable can be determined by subtracting the corresponding balance sheet figures for the previous year from those for the current year.

The forecasted cash flow indicators, including cash flows from operating, investing, and financing activities related to the investment project, are presented in Table 4.

Table 4

Selected indicators of projected cash flow statement (consensus scenario), USD

	2025	**2026**	**2027**	**2028**	…
OPERATING ACTIVITIES:					
Net income	-	-	1,137,750	1,379,548	…
Depreciation	-	-	2,000,000	1,800,000	…
Net changes in working capital	-	-	(531,548)	3181	…
Net cash provided by (used in) operating activities	-	-	**2,606,202**	**3,182,729**	…
INVESTING ACTIVITIES:					
Investments in property, plant, and equipment	(2,000,000)	(18,000,000)	-	-	…
Net cash provided by (used in) investing activities	**(2,000,000)**	(18,000,000)	-	-	…
FINANCING ACTIVITIES:					
Issuance (repayment) of debt		14,000,000	(2,800,000)	(2,800,000)	…
Issuance (repayment) of equity	6,500,000	-	-	-	…
Net cash provided by (used in) financing activities	**6,500,000**	**14,000,000**	**(2,800,000)**	**(2,800,000)**	…
Opening cash balance	-	4,500,000	500,000	306,202	…
Net increase (decrease) in cash	4,500,000	(4,000,000)	(193,798)	382,729	…
Closing cash balance	**4,500,000**	**500,000**	**306,202**	**688,931**	…

The closing cash balance is incorporated into the “Cash” line of the balance sheet to complete the balance sheet forecast.

5.3. Assessment of investment profitability and liquidity

The third stage of investment analysis involves assessing the profitability and liquidity of the investment. It includes the following components:

- Forecasting the vessel’s market value at the end of the project period, taking into account the degree of asset depreciation and anticipated market freight rates, which influence the vessel’s resale value on the secondary market.
- Year-by-year projection of free cash flow to equity.
- Determination of the weighted average cost of capital.
- Evaluation of discounted cash flow (DCF), net present value (NPV), internal rate of return (IRR), and other performance indicators derived from projected cash flows.
- Estimation of the payback period and discounted payback period to assess investment liquidity.

The total discounted cash flow in the case of pre-delivery equity financing and post-delivery debt financing can be calculated using the following formula:

$$DCF = -\sum_{t=0}^{m} \frac{P_t}{(1+WACC)^t} + \sum_{t=m+1}^{T} \frac{FCFE_t}{(1+WACC)^t} + \frac{S_{residial}}{(1+WACC)^T}, \quad (2)$$

where:
P_t – pre-delivery payment in year t;
m – number of periods until vessel delivery;
T – total duration of investment project, including both construction and operational phases;
$FCFE_t$ – free cash flow to equity in year t;
$S_{residual}$ – forecasted residual market value of the vessel at the end of the project period;
$WACC$ – weighted average cost of capital (expressed as a decimal).

Annual free cash flow to equity represents the amount of cash available to shareholders each year after all obligations, including debt repayments:

$$FCFE_t = Net\,income_t + Depreciation_t + NCWC_t - Cash\,CAPEX_t + Net\,debt_t, \quad (3)$$

where:

$$Net\,debt_t = New\,debt\,issued_t - Debt\,repayments_t. \quad (4)$$

The key indicators of investment profitability and liquidity are presented in Table 5.

Table 5

Selected Indicators of investment profitability and liquidity (consensus scenario)

	2025	**2026**	**2027**	…	**2033**
Free cash flow to equity, USD	(2,000,000)	(4,000,000)	(193,798)	…	16,344,683
Discount factor	1	0.9324	0.8694	…	0.5712
Annual DCF, USD	(2,000,000)	(3,729,604)	(168,482)	…	9,336,801
Total DCF (NPV), USD	**6,019,085**				
IRR, %	**18.7**				
Cumulative cash flow, USD	(2,000,000)	(6,000,000)	(6,193,798)	…	14,201,845
Payback period, years	**7.13**				
Cumulative DCF, USD	(2,000,000)	(5,729,604)	(5,898,086)	…	**6,019,085**
Discounted payback period, years	**7.36**				

The internal rate of return reflects the profitability level of the investment project, while the cumulative DCF or NPV represents its overall economic effect. Investment liquidity is assessed using the payback period and the discounted payback period. The interpretation of these indicators depends on the expected profitability and liquidity thresholds established by the top management of each shipping company. Generally, the IRR should exceed the weighted average cost of capital, and the payback period should fall within the acceptable timeframe (typically five to eight years).

5.4. Analysis of debt coverage by period

The debt service coverage ratio is a key metric for evaluating a company’s ability to meet its debt obligations using cash generated from its operating activities, as it measures how effectively a company’s operating cash flows can cover loan principal and interest payments. The ratio is typically calculated using EBITDA, with context-specific adjustments applied depending on the nature of the financial analysis.

The fourth stage of the investment analysis involves the assessment of debt coverage for each period and includes the following components:

- Calculation of the debt service coverage ratio and evaluation of the ability to cover debt service expenses through EBITDA during each loan repayment period.
- Analysis of the time charter equivalent (TCE) breakeven level and comparison with the average TCE during the loan repayment phase.

- Comparison of the average TCE with the TCE at the beginning of the first operational year.
- Evaluation of the loan-to-value ratio for each period of the investment project.

Key indicators used in the debt coverage analysis are presented in Table 6.

Table 6

Selected indicators for debt coverage analysis (consensus scenario)

	2027	**2028**	**2029**	…
Time charter equivalent (TCE), USD/day	17,000	16,900	16,700	…
EBITDA, USD	4,035,000	3,989,875	3,903,654	…
Interest, USD	647,500	507,500	367,500	…
Repayment of principal debt, USD	2,800,000	2,800,000	2,800,000	…
Debt service coverage ratio (EBITDA/total debt repayment)	1.17	1.21	1.23	…
Total cost (debt service + OPEX), USD	5,532,500	5,401,625	5,275,846	…
Daily breakeven daily TCE, USD/day	15,368	15,005	14,655	…
Average breakeven TCE, USD/day	**15,024**			
Estimated market value of the vessel at the beginning of the year, USD	20,000,000	19,000,000	18,000,000	…
Balance of debt at the beginning of the year, USD	14,000,000	11,200,000	8,400,000	…
Loan-to-value ratio (loan/vessel value), %	70	59	47	…
Security coverage (vessel value/loan), %	143	170	214	…

A higher debt service coverage ratio is generally regarded as more favourable, as it indicates a stronger ability to meet debt obligations from operating cash flows. A debt service coverage ratio below 1.0 is considered critically weak and signals that a company generates insufficient cash to cover its debt-servicing requirements. In practice, most financial institutions, including commercial banks, typically require a minimum debt service coverage ratio of 1.25 to ensure a satisfactory level of creditworthiness.

5.5. Scenario Analysis

The final stage of the investment analysis involves scenario analysis, which includes the following steps:

- Identification of the key drivers influencing profitability indicators. Common factors include market freight rates, revenue, capital expenditures, components of direct OPEX, construction period, and the terminal asset value.
- Development of alternative scenarios and assessment of their associated probabilities.
- Calculation of statistical indicators to assess investment project risk.

Based on the financial model, cumulative DCFs are calculated for each of the 27 scenarios, incorporating variations in key drivers such as the time charter equivalent (TCE), daily OPEX, and loan interest rates. Optimistic scenarios assume higher TCE values (increasing operating revenue), lower OPEX, and reduced interest rates, while pessimistic scenarios incorporate lower TCE, higher OPEX, and elevated interest rates. Scenario probabilities and corresponding DCF outcomes (Fig. 2) are determined using expert judgment and scenario modeling techniques.

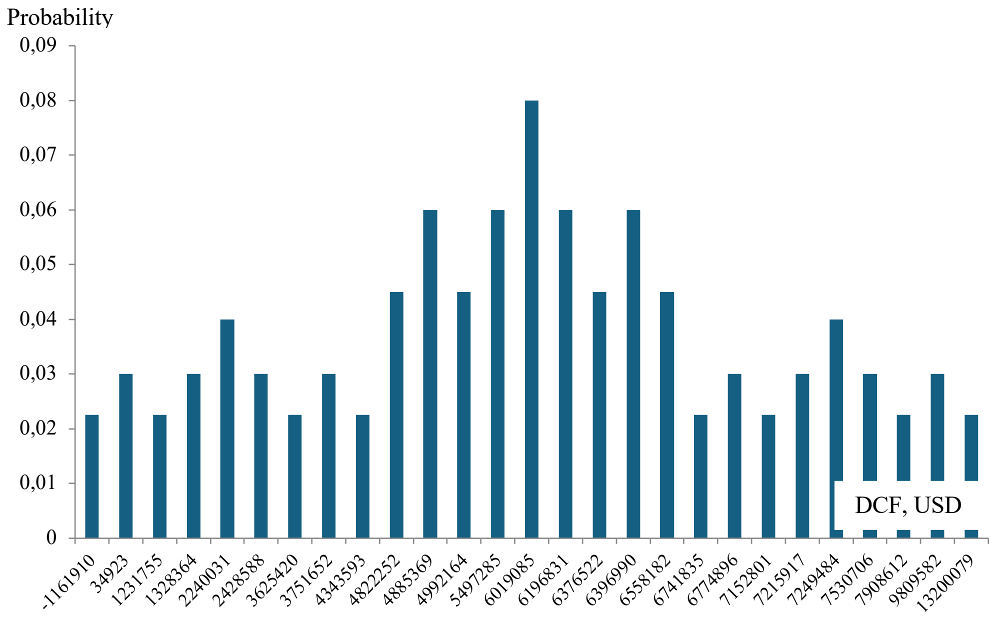

Fig. 2. Probability distribution of project DCF across the considered scenarios

Descriptive statistics summarizing the distribution of discounted cash flows across all scenarios are presented in Table 7.

Table 7

DCF descriptive statistics

Average, USD	5,301,889
Mathematical expectation, USD	5,398,094
Standard error, USD	585,939
Median, USD	6,019,085
Standard deviation, USD	3,044,628
Kurtosis	0.93
Asymmetry	0.05
Amplitude, USD	14,361,989
Minimum, USD	-1,161,910
Maximum, USD	13,200,079
Number of scenarios	27

Assuming that the discounted cash flow of the investment project follows a normal probability distribution, it becomes possible to estimate the likelihood that the DCF will fall within a specified interval defined by upper and lower bounds. The probability that the DCF lies within this interval is determined by the integral of the probability density function over that range:

$$P(\alpha \leq DCF \leq \beta) = F(\beta) - F(\alpha) = \int_{\alpha}^{\beta} f(x)\,dx, \tag{5}$$

where:

a, β – the lower and upper bounds of the interval, respectively;

F(x) – the cumulative distribution function;

f(x) – the probability density function of the normal distribution with specific units of measurement equal to the reciprocal of the variable's unit (i.e., 1/unit of x; in this context, 1/USD).

The probability density function for a normal distribution is defined as:

$$f(x)=\frac{1}{\sigma\sqrt{2\pi}}\cdot e^{-\frac{(x-M)^2}{2\sigma^2}}, \tag{6}$$

where:
σ – standard deviation of DCF, in USD;
M – expected value of DCF (i.e., mathematical expectation), in USD.

The probability density function and its cumulative distribution function are shown in Fig. 3.

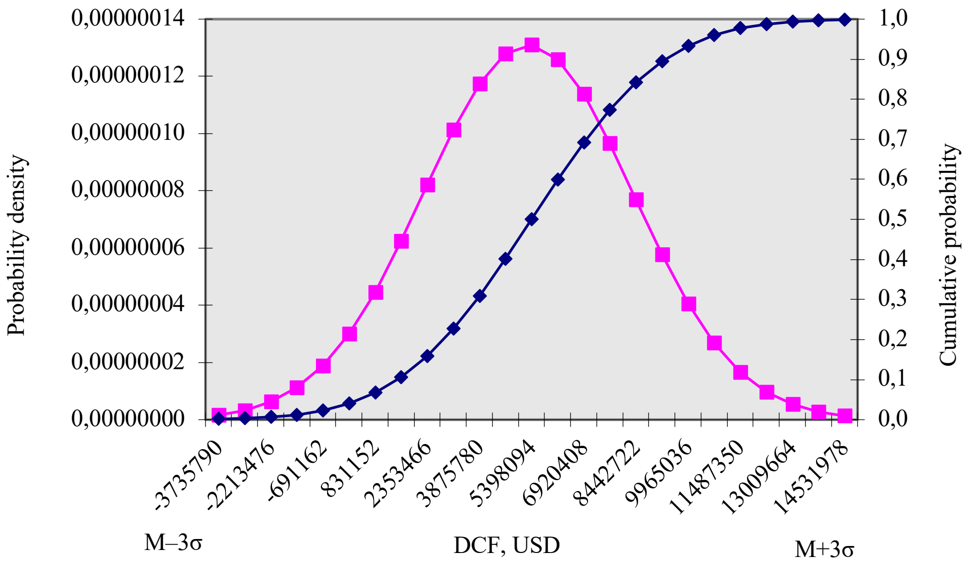

Fig. 4. Probability density function and corresponding cumulative distribution function

The probability that DCF will fall within the interval between its negative minimum value and zero can be estimated using the formula below:

$$P(DCF_{min} \le x \le 0) = \int_{DCF_{min}}^{0} f(x)\,dx = 0.0225 \text{ or } 2.3\%. \tag{7}$$

However, the probability of a negative DCF alone is not a sufficient or acceptable indicator of financial risk, as companies aim not merely to achieve a positive cumulative DCF but to attain a level of return that ensures acceptable profitability. Therefore, the risk associated with discounted cash flows should also account for the extent of deviation from the expected value. The maximum deviation of DCF from its expected value can be expressed as follows:

$$\Delta DCF_{max} = DCF_{expected} - DCF_{min} = -6560004 \text{ USD}. \tag{8}$$

The probability that the DCF will fall within the interval between its minimum value and the expected value can be calculated using Equation (9):

$$P(DCF_{min} \le x \le DCF_{expected}) == \int_{DCF_{min}}^{DCF\,expected} f(x)\,dx = 0.4844 \text{ or } 48.4\%. \tag{9}$$

The probability-adjusted maximum deviation of the project's discounted cash flows from the expected value can then be estimated by Equation (10):

$$\Delta adj = \Delta DCF_{max} \cdot P(DCF_{min} \le x \le DCF_{expected}) = -6560004 \cdot 0{,}4844 = -3177693 \text{ USD}. \tag{10}$$

The project demonstrates a high probability that the DCF will fall within the range between the minimum and expected values. However, it also exhibits a considerable spread in discounted cash flow outcomes, as evidenced by the values of the standard deviation and the coefficient of variation**,** as presented in Tab. 8.

Table 8

Risk assessment metrics

Consensus scenario DCF, USD	6,019,085
Expected value of DCF (M), USD	5,398,094
Standard deviation (σ), USD	3,044,628
Minimum DCF, USD	(1,161,910)
Maximum deviation of DCF from the expected value, USD	(6,560,004)
Coefficient of variation, %	56
Probability of negative DCF, %	2.3
Probability of expected DCF, %	48.4
Probability-adjusted maximum losses, USD	(3,177,693)

The project's risk can be characterized as marginal based on a coefficient of variation of 56%, which reflects the relationship between the level of risk and the expected return on investment. The maximum deviation of DCF from its expected value (USD 6.56 million), along with the maximum potential loss adjusted for probability (USD 3.17 million), further indicates a significantly high level of financial risk.

In general, the most critical risk factor in the shipping industry is market risk, particularly the volatility of freight rates. As such, it is imperative that shipping companies develop and implement risk mitigation strategies to manage exposure to freight rate fluctuations.

Ultimately, the decision regarding the acceptability of proceeding with a project that exhibits this level of risk should rest with the company's senior management. This decision must be informed by the comprehensive results of all preceding analytical stages, including the required return on investment, expected liquidity, and the organization's overall risk tolerance.

6. CONCLUSIONS

From the perspective of ship-owning companies, the proposed methodological approach to financial risk assessment serves as an effective decision-support tool across multiple domains. It facilitates informed investment decisions, for example, by comparing alternative asset types such as dry bulk carriers versus tankers or selecting between new and second-hand vessels. Additionally, it aids in the formulation of commercial strategies, including the selection of chartering arrangements (e.g., time charter, bareboat charter, or spot market operation), and supports financial decisions related to capital structure, such as bank lending or bond issuance. The model also provides a structured framework for evaluating hedging strategies, including the use of freight derivatives or fixed-rate charter agreements to manage market risk.

For banks and other financial institutions operating in the maritime sector, this approach provides a comprehensive means of assessing creditworthiness and determining suitable lending terms. It helps define the permissible level of financial leverage, establish the loan structure and interest rates, and evaluate the likelihood of debt service shortfalls or default events, based on probabilistic scenario analysis and forecasted cash flow volatility.

Crucially, the approach is designed to be universally applicable. With appropriate modifications, the dynamic three-statement financial model can be adapted for use in a wide range of contexts:

- In shipbuilding projects, the model can incorporate staggered capital expenditures, construction milestones, and delivery-based payment structures, allowing for a detailed assessment of pre-delivery financing needs and risk exposure during the shipyard phase.

- In the technical maintenance and repair domain, the model can be tailored to evaluate lifecycle costs, periodic docking schedules, and their financial implications on operational continuity and cash flow profiles.
- Beyond the shipping industry, the framework can be generalized to other sectors of transport infrastructure investment, such as rail, aviation, or port terminals development projects, by adjusting project-specific assumptions (e.g., asset depreciation, revenue generation schemes, and maintenance cycles) while maintaining the core modeling logic.

Furthermore, the methodological approach is applicable to broader corporate finance and strategic planning needs. It can be utilized for mergers and acquisitions modeling, valuation of ongoing businesses, feasibility studies and business plans for start-ups and capital-intensive ventures, and evaluations of project finance structures in public-private partnerships.

In conclusion, the presented methodology offers a robust, flexible, and scalable toolset for comprehensive financial analysis and risk assessment. Its structured integration of forecasting, scenario modeling, and statistical interpretation enhances the decision-making capability of both investors and financiers across various stages of project development and across multiple transport-related industries.

References

1. Bartram, S. & Brown, G. & Waller, W. How important is financial risk? *Journal of Financial and Quantitative Analysis.* 2015. No. 50(4). P. 801-824.
2. Maverick, J.B. *Financial risk: the major kinds that companies face*. Investopedia. 2022. Available at: https://www.investopedia.com/ask/answers/062415/what-are-major-categories-financial-risk-company.asp.
3. Qian, K. & Duan, G.-J. & Peng-fei, Zh. Research on risk management strategy of shipping enterprise. *Journal of Shipping and Ocean Engineering.* 2015. No. 5. P. 75-79.
4. Mousavi, M. & Ghazi, I. & Omaraee, B. Risk assessment in the maritime industry. *Engineering Technology and Applied Science Research.* 2017. No. 7(1). P. 1377-1381.
5. Cheolhwan, H. *Risk management strategies of shipping companies*. Cello Square. 2022. Available at: https://www.cello-square.com/go-en/blog/view-226.do.
6. Bazaluk, O. & Zhykharieva, V. & Vlasenko, O. et al. Optimization of the equity in formation of investment portfolio of a shipping company. *Mathematics*. 2022. Vol. 10. P. 363. DOI: 10.3390/math10030363.
7. Kelly, D. & Lupa, M. & Paz de Araujo, M. et al. Asset management of vehicles: a practical application of the logic scoring of preference method of optimizing programmatic investment decisions in a performance based system. In: *Procedia Computer Science.* 2014. Vol. 32. P. 681-690.
8. Stopford, M. *Maritime Economics*. Third edition. New York: Routledge. 2009. 815 p.
9. Norton, S. *Shipping Finance.* UK: Institute of Chartered Shipbrokers, 2021. 170 p.
10. Cullinane, K. A portfolio analysis of market investments in dry bulk shipping. *Transportation Research Part B: Methodological*. 1995. Vol. 29. No. 3. P. 181-200.
11. Damodaran, A. *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*. Third edition. New York: John Wiley & Sons Inc. 2012. 992 p.
12. Schmidt, J. *Building a Three-Statement Model*. Corporate Finance Institute. 2020. Available at: https://corporatefinanceinstitute.com/resources/financial-modeling/3-statement-model/.
13. Zhykharieva, V. & Kozyr, O. Methodical approach to complex investment analysis of cash flows on the example of the fleet replenishment project. *Economy and Society.* 2022. No. 43. DOI: 10.32782/2524-0072/2022-43-16.

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