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MODERN MODEL OF ANALYSIS OF THE FINANCIAL LEVERAGE EFFECT OF ENTERPRISES IN A CHANGING ENVIRONMENT

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СУЧАСНА МОДЕЛЬ АНАЛІЗУ ЕФЕКТУ ФІНАНСОВОГО ВАЖЕЛЯ ПІДПРИЄМСТВ У ЗМІННОМУ СЕРЕДОВИЩІ

In today's business environment, analyzing corporate financial leverage has become increasingly complex due to higher uncertainty, greater financial market volatility, and rapid changes in macro- and microeconomic conditions. Under these circumstances, classical approaches to assessing financial leverage—which assume relative stability of capital cost parameters, financing structure, and projected financial results—are increasingly insufficient for accurately reflecting the actual level of financial risk faced by enterprises. Accordingly, the aim of this article is to define a contemporary model for analyzing the financial leverage effect of enterprises under conditions of heightened economic instability and dynamic changes in key financial indicators. The study emphasizes that in modern methodologies, it is particularly important to integrate scenario analysis, stochastic modeling, and adaptive coefficients. This approach allows for consideration of the dynamic variability of key parameters that directly influence the financial stability of an enterprise. As a result, management is provided with a tool to promptly assess the financial leverage effect, forecast risk zones, and determine optimal strategies for managing capital structure. It is demonstrated that the integration of these elements transforms the classical deterministic model of financial leverage analysis into a flexible framework capable of accounting for scenario developments, probabilistic ranges of financial outcomes, and rapid responses to external shocks. The authors highlight the practical value of this flexible financial leverage analysis model, particularly its ability to enable enterprises to balance the use of debt capital to enhance return on equity while simultaneously minimizing financial risks and improving resilience to market fluctuations. Further research could focus on developing visualization tools for financial leverage trajectories in the "time — scenario — financial parameters" space, as well as integrating modern machine learning methods to forecast financial results in unstable environments.

У сучасних умовах господарювання аналіз фінансового важеля підприємств зазнає суттєвого ускладнення, що зумовлено зростанням рівня

невизначеності, посиленням волатильності фінансових ринків та динамічними змінами макро- і мікроекономічного середовища. За таких умов класичні підходи до оцінювання фінансового важеля, які ґрунтуються на припущенні, щодо відносної стабільності параметрів вартості капіталу, структури фінансування та прогнозованих фінансових результатів, дедалі частіше виявляються недостатніми для адекватного відбиття реального рівня фінансового ризику підприємства. Відтак метою статті є визначення сучасної моделі аналізу ефекту фінансового важеля підприємств в умовах підвищеної економічної нестабільності та динамічних змін ключових фінансових показників. Констатовано, що у сучасній методології аналізу ефекту фінансового важеля особливо важливо інтегрувати сценарний аналіз, стохастичне моделювання та адаптивні коефіцієнти. Завдяки цьому менеджмент отримує інструмент для оперативного оцінювання ефекту фінансового важеля, прогнозування зон ризику та визначення оптимальних стратегій управління структурою капіталу. Доведено, що інтеграція таких елементів дозволяє перетворити класичну детерміновану модель аналізу ефекту фінансового важеля підприємств на гнучку (здатну враховувати сценарії розвитку подій, ймовірнісні інтервали фінансових результатів та швидко реагувати на зовнішні шоки). Звернено увагу на практичну цінність гнучкої моделі аналізу ефекту фінансового важеля, зокрема на те, що вона дозволяє підприємству отримати можливість збалансовано використовувати позиковий капітал для підвищення рентабельності власного капіталу, одночасно мінімізуючи фінансові ризики та підвищуючи стійкість до коливань ринкових умов. Подальші дослідження можуть бути спрямовані на розробку інструментів візуалізації траєкторій ефекту фінансового важеля у просторі «час — сценарій — фінансові параметри» та інтеграцію сучасних методів машинного навчання для прогнозування фінансових результатів у нестабільному середовищі.

Keywords: *financial risk; enterprise; cost of capital; capital structure; financial performance forecasting; financial leverage effect.*

Ключові слова: *фінансовий ризик; підприємство; вартість капіталу; структура фінансування; прогноз фінансових результатів; ефект фінансового важеля.*

Problem statement. Within the scope of this study, it is argued that, in both the Ukrainian and international economic context, the increasing instability of the business environment after 2022 necessitates a revision of traditional approaches to calculating financial leverage. An increasing number of consulting and analytical organizations, including Deloitte, PwC, KPMG, and EY, note that, methodologically, financial leverage is undergoing a transformation—from a deterministic model of research procedures to a dynamic, flexible approach that takes into account the temporal variability of interest rates, fluctuations in profitability, inflation expectations, currency risks, as well as information asymmetry among participants in financial markets.

This is due to the fact that, prior to 2022, the financial markets of Ukraine and many other countries were characterized by relative macro-financial stability, evidenced by low and predictable inflation, moderate interest rates, and foreseeable monetary policy. For instance, during 2015–2021, the National Bank of Ukraine adhered to an inflation-targeting regime with an official inflation target of 5%, and the key policy rate changed gradually, creating conditions for stable planning of investment and financial activities of enterprises. Similar trends were observed in most developed countries, where central banks (the U.S. Federal Reserve, the European Central Bank, and the Bank of England) maintained a prolonged period of accommodative monetary policy and low base rates. According to World Bank estimates, the global average inflation rate in the pre-crisis period remained relatively stable, averaging no more than 3–4%, which facilitated a reduction in the cost of capital and the widespread use of deterministic approaches to its analysis.

Analysis of research and publications. The issue of analyzing financial leverage and its impact on the efficiency and financial stability of enterprises has been extensively examined in the works of both domestic and foreign scholars. Classical approaches to analyzing enterprise financial leverage have been discussed in the studies of N.M. Davydenko [2], I.V. Demyanenko, S.V. Petryk [3], and Z.D. Kalinichenko [4]. These authors pay significant attention to the methodology of classical calculation of the financial leverage effect, determining the optimal ratio of equity to borrowed capital, as well as analyzing the impact of the cost of borrowed resources on the financial performance of economic entities.

At the same time, the proposed approaches are based on the use of static models, which do not fully account for the dynamic nature of the external environment and the variability of key financial indicators over time.

The issues of adapting financial leverage analysis to conditions of increased economic instability, fluctuations in interest rates, changes in tax regulation, and volatility of operating income remain insufficiently studied, which highlights the need for further research in this area.

Formulation of the article's objectives. The aim of this article is to identify a modern methodological approach for analyzing the financial leverage effect of enterprises under conditions of increased economic instability and dynamic changes in key financial indicators.

The paper main body. The authors highlight that, following the full-scale invasion of Ukraine by the Russian Federation, there has been a significant increase in the volatility of macroeconomic indicators, exchange rates, and corporate financial performance, accompanied by changes in market participants' access to relevant information. These developments have contributed to an acceleration of global inflationary pressures: according to international financial institutions, the average global inflation rate reached approximately 7.5% in 2022 and 6.4% in 2023, substantially exceeding the long-term average of around 3.8%. This surge in inflation has largely resulted from the consequences of the war,

including sharp increases in energy and food prices and disruptions in global supply chains.

The cumulative impact of these factors has created objective conditions for a transition from deterministic to flexible approaches in capital structure management, along with a corresponding transformation of the methodologies employed to apply financial leverage. Importantly, this does not refer merely to the general economic concept of using borrowed capital to enhance return on equity, but specifically to the quantitative assessment of financial leverage's effect on equity profitability (EFL)—that is, how changes in capital structure influence ROE through debt levels [5-6].

The proposed approach involves a model that simultaneously evaluates risk and potential return, enabling management to identify zones where financial leverage is beneficial and areas where it may become critical or negative. In dynamic and uncertain conditions, this capability is further enhanced through the integration of scenario analysis, stochastic modeling, and adaptive coefficients into traditional models for calculating the financial leverage effect (see Table 1).

Table 1. Logic of integrating scenario analysis, stochastic modeling elements, and adaptive coefficients into traditional financial leverage calculation methods

Integrated elements	Specifics of Integration into financial leverage calculation	Impact on traditional financial leverage methods
Scenario analysis	Construction of alternative scenarios (base, optimistic, pessimistic) with varying interest rates, inflation, exchange rates, and operating income	Enables assessment of the sensitivity of the financial leverage effect to changes in the external environment and identification of critical levels of financial risk
Stochastic modeling	Use of probability distributions for interest rates and operating income; simulation-based forecasting methods	Facilitates the transition from point estimates to probabilistic assessments, improving the accuracy of financial leverage impact forecasts
Adaptive coefficients*	Adjustment of the cost of debt and equity, taking into account currency risks, inflation expectations, and changes in liquidity	Enhances the relevance of financial leverage assessment under unstable conditions, providing flexible capital structure management

Note:
Traditional financial leverage models use fixed debt rates, constant capital structure, and stable projected profits.

Source: created by the authors based on [1-2; 6-7]

So, integrating scenario analysis into traditional financial leverage calculation methods allows modeling of various potential developments, such as changes in interest rates, fluctuations in profitability, or exchange rates. Each scenario is evaluated separately, enabling enterprises to forecast the effect of financial leverage under different conditions and to identify the most risky or optimal financing strategies. For example, a company can estimate the impact of a 2% increase in the key interest rate on net profit and return on equity across three scenarios: optimistic (sales and profit increase by 5%), base (profit remains stable), and pessimistic (profit decreases by 5%). Such analysis allows management to make informed decisions regarding the amount of debt and capital structure, thereby minimizing the risk of financial losses [5].

Stochastic modeling, when integrated into traditional financial leverage calculation methods, enables the use of random variables and probability distributions for key indicators (profitability, inflation, and exchange rate fluctuations) [6]. This approach allows for the assessment of probabilistic ranges of financial leverage outcomes and accounts for the uncertainty of the market environment. For instance, a company can model the probability distribution of net profit on equity given a variation in the USD/UAH exchange rate of ±10% and operating income fluctuations of ±15%. The modeling results indicate the likelihood of achieving positive returns under different conditions and help management assess financial risk while selecting optimal parameters for debt financing.

The transition to adaptive coefficients in financial leverage calculations involves the dynamic adjustment of equity and debt cost parameters, taking into account changes in macroeconomic conditions, currency risks, inflation expectations, and liquidity variations. These coefficients are integrated into financial models as multipliers applied to key parameters (EBIT, WACC, debt rate [5]) to reflect real, changing market conditions. Examples include the use of a coefficient to adjust the cost of debt (e.g., if the market interest rate rises, the coefficient adapts the financial leverage calculation to account for higher debt

servicing costs [6]) or inflation adjustment (e.g., if inflation increases, the coefficient adjusts the calculation of capital cost and projected profit [4]). This approach allows a company to promptly adapt its capital structure to new economic realities, providing a more accurate assessment of financial risk and enhancing the efficiency of debt utilization in a volatile environment.

Thus, the method for calculating financial leverage can no longer be based on a fixed set of parameters. It assumes a staged and dynamic nature, requiring regular updates of key indicators in accordance with changes in macroeconomic and market conditions. The operation and overall logic of the financial leverage calculation algorithm can be summarized as follows [3-5]:

1. Parameter identification becomes time-dependent. Instead of using averages or single-point values, time series are defined for the cost of debt kd(t), operating income EBIT(t), tax rate T(t), and currency and inflation adjustments (if applicable).
2. Stationarity of the business environment is introduced. Base, optimistic, and pessimistic scenarios (or probabilistic combinations thereof) are constructed, within which key parameters affecting financial leverage values are varied.
3. Calculation of the modified financial leverage effect is performed. For each scenario and time period, the financial leverage effect is determined not as a static ratio but as a function of the underlying variables.

Effectively, this approach shifts from a one-time insertion of values into the classical formula to a functional dependency of the result on time-varying parameters.

So, in its classical form, the methodological model for analyzing the financial leverage effect (EFL) is based on a fixed ratio, where all indicators are considered constant, such as in equation (1) or its variations [1; 5].

$$EFL=(ROA-kd) * \text{Debt-to-Equity}, \quad (1),$$

where:

EFL — financial leverage effect (return on equity generated through debt financing);

ROA — return on assets of the enterprise; k_d — cost of debt (interest rate on debt);

Debt-to-Equity (D/E) is a financial ratio that reflects the proportion of a company's debt (borrowed capital) relative to its equity.

In the modified interpretation, the methodological model for analyzing the financial leverage effect is based on calculations in which each of the classical elements is transformed into a variable that depends on time and scenario. Under these conditions, algorithmically, the financial leverage effect is expressed as a function:

$$EFLs(t)=(ROAs(t)-kd,s(t))\ Es(t)/Ds(t), \quad (2),$$

where t denotes the time period and s represents the environmental scenario (base, pessimistic, optimistic).

A more detailed specification of the transition from a static to a scenario-dynamic model for calculating the financial leverage effect is presented in Table 2.

Table 2. Specification of the transition from a static to a scenario-dynamic model for calculating the financial leverage effect

Scenario / period	Cost of debt kd(t)	Return on assets ROA(t)	Capital structure D/E(t)	EFLs(t)	Interpretation of the State
Optimistic, t_1	Low (cheap debt)	High	Moderate debt ratio	High positive	Debt financing enhances return on equity
Optimistic, t_2	Moderate	High	Increasing	Positive but decreasing	Sensitivity of ROE to debt load increases
Base, t_1	Moderate	Stable	Stable	Slightly positive	Leverage effect limited, risk controlled
Base, t_2	Rising	Moderate	Unchanged	Approaching zero	Boundary between positive and negative effect
Pessimistic, t_1	High	Decreasing	High debt ratio	Negative	Debt reduces return on equity
Pessimistic, t_2	Very high	Low	High	Strongly negative	Financial instability risk increases

Source: created by the authors based on [3; 5-6]

Therefore, from a theoretical perspective, financial leverage in contemporary conditions has evolved into a dynamic indicator, capable of changing both its sign and magnitude depending on the scenario and the time period. It serves not only as a measure of capital efficiency but also as a key indicator of an enterprise's financial stability. In practical terms, this entails that:

1. Each scenario is assigned its own trajectory for changes in interest rates, return on assets, and capital structure;
2. For each time period, a distinct financial leverage effect is calculated;
3. The outcome is not a single static value, but rather a set of values or a range, reflecting how financial leverage evolves in response to both external and internal factors.

In our view, from a modeling perspective, the financial leverage effect should be interpreted as a trajectory of values in the "time — scenario — financial parameters" space, rather than as a static expression [7].

In practical terms, this approach allows for the identification of critical zones where the positive effect of financial leverage transitions into a negative one, as well as for the assessment of an enterprise's financial stability boundaries under conditions of economic instability (based on the values of the financial leverage effect (EFL) at which the enterprise remains financially stable, or when the risk exceeds an acceptable level). For example, if in 2024, LLC "Alpha-Prom" had a debt-to-equity ratio of D/E=1.0, its financial strategy would exhibit high sensitivity to changes in borrowing costs and asset profitability, effectively defining the boundaries of financial stability for this entity.

By considering financial leverage as a trajectory in the "time — scenario — financial parameters" space (see Table 3), the management of LLC "Alpha-Prom" is able not only to outline these boundaries for 2025 but also to develop strategies for managing debt load and asset profitability within acceptable risk limits. This assessment is based on the dynamics of key indicators, such as return on assets and the cost of debt, enabling the adaptation of financial strategy to changing economic conditions.

Table 3. Dynamics of Financial Leverage of LLC "Alpha-Prom" in the "time — scenario — financial parameters" space, 2025

Scenario / Period*	ROA, %	Cost of Debt kd, %	ROA − kd, p.p.	Financial leverage effect	Nature of Effect	Interpretation of Financial Stability Boundary
Base, t_1	14	9	+5	+5.0	Stable positive	≥ +5.0 – high stability margin
Base, t_2	12	10	+2	+2.0	Positive but weak	+2.0 – +5.0 – medium stability margin
Base, t_3	10	10	0	0.0	Critical boundary	0.0 – lower stability limit
Pessimistic, t_4	9	11	−2	−2.0	Negative	< 0 – beyond financial stability boundary
Pessimistic, t_5	8	13	−5	−5.0	Strongly negative	≤ −5.0 – loss of financial stability

Note:
t_1–t_5 represent analytical states (quasi-periods) of the financial environment within 2025, reflecting different possible combinations of key financial parameters depending on the scenario.
Source: created by the authors

If we consider that each period in Table 2 represents a specific combination of return on assets and cost of debt, shaped by market conditions, monetary policy, and the enterprise's internal performance, then the calculation of financial leverage for LLC "Alpha-Prom" and the determination of its financial stability boundaries should be based on interpreting t1–t5 as a trajectory over the 2025 forecast horizon:

- In t1 (the initial phase of the base scenario), the enterprise remains within a comfortable financial stability zone: return on assets significantly exceeds the cost of debt, resulting in a stable positive financial leverage effect.
- In t2 (a deterioration within the base scenario), the financial leverage trajectory declines, indicating that return on equity is becoming increasingly sensitive to changes in interest rates and operational performance.
- In t3, the critical boundary is reached, where the difference between return on assets and the cost of debt equals zero, and the financial leverage effect effectively loses its economic meaning.

- States t4–t5 correspond to the pessimistic scenario, where rising debt costs and declining ROA push the financial leverage trajectory into negative territory, meaning that debt financing begins to erode the enterprise's financial stability.

Thus, the periods t1–t5 form a conditional trajectory of the enterprise's movement between zones of financial stability, critical boundaries, and financial instability, enabling management to identify critical points before actual deterioration in financial performance occurs, as is evident in the financial leverage trajectory graph for LLC "Alpha-Prom" in 2025:

- In t1, ROA = 14 %, cost of debt = 9 %, difference = +5 p.p. → financial leverage effect = +5 p.p. (positive), indicating a high margin of financial stability.
- In t2, under worsening market conditions, ROA = 12 %, cost of debt = 10 %, the effect decreases to +2 p.p., approaching the critical boundary. The enterprise remains financially stable, but the risks increase.
- In t3, ROA = 10 %, cost of debt = 10 %, effect = 0 → representing the critical threshold of financial stability.
- In t4–t5, the enterprise moves beyond the limits of financial stability, and the effect becomes negative (−2…−5 p.p.), signaling a threat to financial stability or its actual loss.

In practice, examining this model in action clearly demonstrates that financial leverage should not be interpreted as a single static measure, but rather as a dynamic trajectory reflecting the transition from zones of financial stability to zones of heightened risk under conditions of an unstable economic environment.

Conclusions. The study highlights that in modern methodologies, it is particularly important to integrate scenario analysis, stochastic modeling, and adaptive coefficients (which are incorporated into financial models as multipliers applied to key parameters such as EBIT, WACC, and the cost of debt, reflecting real and changing market conditions). This approach allows enterprises to account

for the dynamic variability of key parameters that directly influence financial stability.

As a result, management gains a practical tool for promptly assessing the financial leverage effect, forecasting risk zones, and determining optimal strategies for managing the capital structure. At the same time, integrating these elements transforms the classical deterministic model of financial leverage analysis into a flexible framework, capable of incorporating scenario developments, probabilistic ranges of financial outcomes, and responding quickly to external shocks.

The practical value of this approach is clear: it enables enterprises to use debt in a balanced manner to enhance return on equity, while simultaneously minimizing financial risks and improving resilience to market fluctuations.

Future research could focus on developing visualization tools for tracking financial leverage trajectories in the “time — scenario — financial parameters” space, as well as integrating modern machine learning methods to forecast financial outcomes in unstable environments.

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