

ACCOUNTING FOR INFLATION PROCESSES IN THE ANALYSIS AND EVALUATION OF THE EFFECTIVENESS OF INVESTMENT PROJECTS

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**Annotation.** *The article is devoted to the analysis of the impact of inflation on the assessment of the effectiveness of investment projects and the development of methods for accounting for inflation processes. Inflation forecasting, cash flow adjustments and accounting for the heterogeneity of income and cost inflation are considered. A modified NPV formula is presented that takes into account inflation adjustments, and scenario approaches for integrating inflation risks are proposed. The developed methods ensure increased accuracy of financial analysis and sustainability of investment decisions in an unstable economy.*

**Keywords:** *inflation, investment projects, NPV, inflation risks, financial analysis.*

**Introduction**

The modern global economy faces increasing uncertainty, where inflation plays a central role, significantly affecting long-term investment strategies and financial assessments. Inflation, manifested in a steady increase in prices, undermines the purchasing power of money, distorts nominal financial flows and complicates forecasting. This makes traditional methods of evaluating investment projects insufficiently accurate, which requires the development of new approaches that allow for inflation risks and adaptation to changing economic conditions.

The uneven impact of inflation on the income and expenditure components of investment projects is particularly complex. The impact of inflation on the cost of resources, labor, and financial capital creates an asymmetry that requires consideration in cash flow modeling and the calculation of performance indicators. In this context, the integration of inflation processes into financial analysis becomes a prerequisite for improving the accuracy of assessment and ensuring the sustainability of projects in an unstable macroeconomic environment.

**Purpose of the study.**

The main objective of this study is to identify the impact of inflationary processes on the evaluation of investment projects and to develop methodological approaches that improve the accuracy of financial analysis and the sustainability of investment decisions.

**Research objectives.** To achieve this goal, it is necessary to solve the following tasks:

1. To systematize the theoretical foundations of inflation, its types and mechanisms of influence on the economy.
2. To conduct a critical review of investment project evaluation methods and identify their limitations in the context of inflation.
3. Develop approaches to integrating inflation processes into the financial analysis of investment projects.

**Relevance of the study**

This study is relevant in the context of growing macroeconomic instability and accelerating inflation processes, which create new challenges for investors and analysts. The development of adaptive

methods for assessing investment projects that take into account inflation risks is necessary to ensure the accuracy of financial forecasts, improve the efficiency of investment decisions and minimize economic losses. The results obtained are of practical importance for companies forming investment strategies and contribute to the development of theoretical and applied approaches to the analysis of inflation in the economy.

### Literature Review

Modern studies of the problem of accounting for inflation processes in the analysis of investment projects demonstrate a significant diversity of approaches and solutions reflecting the relevance of this topic in conditions of economic instability.

The textbook by A. V. Vorontsovskiy "Risk Assessment" examines various methods of assessing and measuring the risks of investment projects in the real sector of the economy; the features of assessing multi-period risk investments are shown<sup>1</sup>; methods are given for substantiating the current value of risky capital assets and the size of investments in risky investment projects.

In the book "Investment projects. Risk analysis and efficiency assessment" (Shveikin I. E., Varlamova T. P., Plotnikova M. V.) the theories and practice of investment decision-making are considered, the basics of the methodology of investment design are considered: principles of selection of investment projects, methods of optimizing the life cycle of investments and cash flows, investment risks, methods of assessing the economic efficiency of investments attracted to the real sector of the domestic economy.

R. G. Ibragimov's article "Effects of inflation and their modeling in investment assessment problems" examines the mechanisms of direct and indirect impact of inflation on key financial indicators, including the present value of future cash flows<sup>2</sup>. The author emphasizes the importance of using computer modeling as a tool for taking into account inflationary effects in investment assessment and capital budgeting processes, which helps reduce the uncertainty of forecasts.

A. V. Lentsova in the work "Problems of accounting for inflation in the evaluation of an investment project and its impact on performance indicators" conducts a comparative analysis of methods for accounting for inflation when calculating the net present value (NPV)<sup>3</sup>. The author developed a classification of inflation accounting methods and identified their advantages and disadvantages, emphasizing that ignoring inflationary processes can lead to a distortion of the final assessment of the project's effectiveness and the occurrence of financial losses.

In the article "The Impact of Inflation on the Performance Indicators of an Investment Project" by A. A. Kurilova and T. V. Polteva the main methods of accounting for inflation in assessing investment projects are systematized. The authors analyze the advantages and limitations of various methods and offer practical recommendations for their application, which allows for increasing the accuracy of assessing the effectiveness of projects.

D. S. Sporov has shown in the work named "Principles of assessing the effectiveness of an investment project and taking risks into account when assessing effectiveness" focuses on the methodological

<sup>1</sup>Vorontsovskiy, A. V. Risk assessment: textbook and practical training for universities / A. V. Vorontsovskiy. - Moscow: Yurait Publishing House, 2023. - 179 p. - (Higher education). - ISBN 978-5-534-02411-1.

<sup>2</sup>Ibragimov R.G. «Inflation effects and their modeling in investment assessment problems» Financial Analytics: Problems and Solutions, no. 26 (260), 2015, pp. 33-52.

<sup>3</sup>Lentsova, A. V. (2013). Problems of accounting for inflation when evaluating an investment project and its impact on performance indicators. Scientific results of the year: achievements, projects, hypotheses, (3), 185-191.

aspects of taking inflation risks into account<sup>4</sup>The author identifies the main groups of investment risks that arise at various stages of project implementation and emphasizes the need to integrate them into the assessment process, especially in conditions of inflationary fluctuations.

Thus, modern research offers a wide range of approaches to accounting for inflation in the financial analysis of investment projects, from the use of basic indices to the application of complex scenario models and computer modeling. These works emphasize the importance of a systematic approach to the analysis of inflation as a key element in increasing the accuracy and reliability of the assessment results.

### Methodology

The study of the impact of inflation processes on the evaluation of investment projects is based on a combination of theoretical and practical methods of analysis. The methodology includes a systematic approach to the study of economic processes associated with inflation and the development of models that allow for inflation risks to be taken into account in financial analysis. The main stages of the study, methods and tools used are presented below.

### Theoretical basis:

The methodology is based on the concepts of inflation set out in the works of classical and modern economists, including the theory of nominal and real rates of return, as well as the Irving Fisher inflation premium model. Particular attention is paid to the concepts of uniform, homogeneous and constant inflation, which allows for the formation of accurate scenarios for economic and mathematical modeling.

### Research methods:

1. **Literature Analysis:** a review of the modern theoretical base and practical approaches to accounting for inflation in investment projects was conducted.
2. **Economic and mathematical modeling:** models for calculating net present value (NPV) have been developed that take into account the heterogeneity of inflation in terms of income and costs.
3. **Scenario approach:** used to take into account various scenarios of inflation processes, including high volatility of inflation rates and their impact on the financial stability of projects.
4. **Statistical analysis:** to assess inflation parameters (rates, indices), methods of regression analysis and time series processing are used.

### Analysis process:

1. **Cash flow adjustment:** the methodology uses two approaches: with and without preliminary inflation correction. For this, inflation indices (Paasche, Laspeyres, GDP deflators) are used to bring future cash flows to base values.
2. **Calculation of nominal and real rate of return:** includes the consideration of the inflation premium determined on the basis of the Fisher model.
3. **Evaluation of project effectiveness:** NPV is calculated taking into account inflation adjustments, which allows for differences in the rates of inflation of income and costs.

### Formulas and models

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<sup>4</sup>Sporov, D. S. Principles of assessing the effectiveness of an investment project and taking into account risks when assessing effectiveness / D. S. Sporov. - Text: direct // Young scientist. - 2024. - No. 48 (547). - P. 114-116.

To account for inflation in efficiency calculations, a modified NPV formula is used.<sup>5</sup>:

$$NPV = \sum_{t=1}^T \frac{[G_t \prod_{n=1}^t (1+\pi_n) - C_t \prod_{n=1}^t (1+\pi'_n)] \times (1-\alpha) + D \times \alpha}{(1+\bar{K})^t} - K,$$

where  $G_t$  – nominal revenue of the  $t^{\text{th}}$  year, estimated for an inflationary situation, i.e. in the prices of the base period;  $\pi_n$  – the rate of income inflation in the  $n^{\text{th}}$  year;  $C_t$  – nominal costs of the  $t^{\text{th}}$  year in the prices of the base period;  $\pi'_n$  – the rate of cost inflation in the  $n^{\text{th}}$  year;  $\alpha$  – profit tax rate;  $D$  – annual depreciation charges;  $K$  – initial project costs;  $\bar{K}$  – The “price” of capital, including the inflation premium;  $\prod$  – the multiplication sign.

### Practical significance

The methodology allows:

- Take into account the impact of inflation on project revenues and costs.
- To model various scenarios of inflation processes.
- Improve the accuracy of calculations of performance indicators such as NPV.
- Develop recommendations for managing inflation risks.

Thus, the proposed methodology provides a systematic approach to the analysis of investment projects, taking into account inflation processes and their impact on key financial indicators. This creates the basis for the formation of sustainable investment decisions in conditions of economic instability.

### Analysis

Inflation is one of the key factors influencing the assessment of the effectiveness of investment projects, since it devalues funds, adjusting the financial feasibility indicators. These changes are especially significant for projects with a long investment cycle, high levels of borrowed capital or multiple currency flows. Analysis shows that ignoring inflation leads to serious errors in calculations, which requires the introduction of appropriate adjustments at all stages of the assessment.

### Characteristics of inflation and their accounting

Inflation is defined as a process of steady growth of the general price level, leading to a decrease in the purchasing power of money. Depending on the price dynamics, a distinction is made between uniform – the rate of inflation remains constant throughout the entire calculation period, homogeneous – the rate of price change depends only on time, but not on the nature of goods or services, and constant inflation – the level of inflation does not change over time. These categories are important for developing models used in assessing investment projects.

Indexation is the main instrument for preserving the real value of money.

The applied indices include:

1. **Individual price index**– for certain types of goods and services:

$$I^i = \frac{P_t}{P_0},$$

where  $P_t$  – the price of the product at a given time ( $t$ ),  $P_0$  – price in the base period.

2. **Paasche aggregate index**– for the product group:

$$I_t^i = \frac{\sum P_t \times Q_t}{\sum P_0 \times Q_t}$$

Where  $Q_t$  – the quantity of products sold during a period of time.

<sup>5</sup>Yakovleva N.A. Ya47 Analysis of the effectiveness of investment projects (taking into account the time factor, risk and inflation): Textbook - Minsk: BSU, 2000. - 63 p.

3. **Laspeyres index** – to estimate revenue adjusted for inflation:

$$I_{t,t_0}^i = \frac{\sum P_t \times Q_t}{\sum P_0 \times Q_0} = \frac{B_t}{B_0}$$

Where  $Q_0$  – the quantity of products sold over the previous period of time.

4. **Core price index** – is determined by dividing the prices at each moment in time by the price taken as the base:

$$I_{t\Delta} = \frac{P_t}{P_\alpha}$$

∂e  $P_\alpha$  – the base price of the product at the time of calculation.

5. **Chained price index** – is determined by dividing the prices at a subsequent moment in time by the price at the previous moment in time:

$$I^n = \frac{P_t}{P_{t-1}}$$

These indices are used to adjust cash flows, which ensures comparability of results in the face of changing price levels.

### The Impact of Inflation on Performance Indicators

The main aspects of the impact of inflation on projects include:

- **Inflation heterogeneity:** differences in the rates of inflation between revenues and costs make forecasting difficult and can significantly reduce profitability.
- **Inflation premium:** to compensate for the inflationary depreciation of money, an inflation premium calculated using the Irving Fisher formula is included in nominal rates of return:

$$1 + i = (1 + r) \times (1 + \pi) = 1 + r + \pi + r\pi,$$

∂e  $i$  – nominal rate of return,  $r$  – the real rate of return,  $\pi$  – the projected rate of inflation, provided that all values are expressed as decimals.

When the real rate of return  $r$  and the inflation rate  $\pi$  are small (for example, countries with developed market economies), then the product of these values  $r\pi$  is even more insignificant and can be neglected. Then, by simple transformations, we obtain the form for calculating the inflation premium:  $i = r + \pi$ .

We see that here the predicted inflation rate  $\pi$  and the inflation premium coincide. Therefore, in order for investing to make sense in a developed market, the condition  $i \geq r + \pi$  must be met.

- **Definition of annual inflation rate:** the annual inflation rate can be calculated on a compound interest basis, which allows the cumulative effect of inflation over the course of a year to be taken into account:

$$\pi_{\text{annual}} = (1 + \pi)^{12} - 1,$$

where  $\pi$  is the average monthly inflation rate.

This approach provides a more accurate picture of the inflation rate for the year, taking into account monthly price changes. Incorrect identification of the price index and the inflation rate<sup>6</sup> may lead to errors in data interpretation. Therefore, it is important to take into account the specifics of each indicator for a product or service for an adequate analysis of inflation processes.

- **Accounting for the inflation premium in the nominal rate of return:** to take inflation into account when discounting cash flows, an inflation premium is included in the nominal rate of return:

$$i = r + \pi + r\pi$$

<sup>6</sup>Kuznetsov B. T. Investment analysis: textbook and practical training for universities / B. T. Kuznetsov. - 2nd ed., corrected. and additional. - M.: Publishing house Yurait, 2020 - 363 p.

It should be noted that even at the stage of the initial rejection of projects, those whose profitability is lower than the inflation rate is recognized as obviously ineffective. Such projects do not provide the enterprise with protection from inflation risks.

### The structure of the “price” of capital

The “price” of capital is a key element of investment analysis, which is determined taking into account the following components:

1. **Risk-free portion of the rate of return** — yield on government securities.
2. **Systematic risk premium** — reflects the uncertainty associated with investments in the project.
3. **Inflation premium** — compensates for the depreciation of funds due to inflation.

The total value of these components forms the discount rate used to evaluate the investment project. Accounting for inflation in investment analysis is an important tool for obtaining accurate financial calculations and minimizing the risks associated with changes in the purchasing power of money. There are two main methods of accounting for inflation in cash flow analysis: the method without preliminary inflation adjustment and the method with preliminary inflation adjustment.

**Method without preliminary inflation correction:** this method involves calculating cash flows without taking inflation into account at the stage of their formation.

- **Determination of the nominal rate of return:** the nominal rate of return is calculated taking into account the inflation premium, which provides compensation for expected inflation losses.

- **Calculation of annual annuities:**

$$R_t = (G - C - D) - (G - C - D) \alpha + D = (G - C - D) (1 - \alpha) + D,$$

*zde G – revenue from the project, C – costs (except depreciation charges),  
D – depreciation charges;  $\alpha$  – profit tax rate.*

- **Calculation of Net Present Value (NPV):** the resulting cash flows are discounted at the nominal rate of return. The result allows us to determine the net present value of the project, which is a key criterion for its financial feasibility.

**Pre-inflation adjustment method:** the pre-inflation adjustment method is more accurate because it allows for the impact of inflation to be taken into account at each stage of the cash flow analysis.

- **Determination of the nominal rate of return:** as in the previous method, the nominal rate of return (i) includes the inflation premium.
- **Cash flow adjustment:** revenue (G) and cost (C) flows are adjusted for expected inflation rates ( $\pi$ ) using the formulas:

$$G' = G(1 + \pi)^t, C' = C(1 + \pi)^t.$$

- **Calculation of nominal annuities:** after adjustment, nominal annual annuities are calculated ( $R'_t$ ):

$$R'_t = (G' - C' - D) (1 - \alpha) + D.$$

- **Deflating nominal rents:** to obtain real annual rents, nominal values are cleared of inflation using a deflation factor:

$$R_t = \frac{R'_t}{(1 + \pi)^t}.$$

- **Calculation of net present value:** based on deflated rents, the NPV is calculated. This step is similar to the previous method, but is based on real cash flows.

Table 1.

Comparison of methods

Parameter	Method without correction	Pre-correction method
Accounting for inflation	At the discounting stage	At all stages of analysis
Accuracy	Less	Higher
Risk of NPV overestimation	High	Minimum

The preliminary inflation adjustment method is the preferred tool for analyzing investment projects because it provides a more accurate reflection of the real value of cash flows under inflationary conditions. Adjusting cash flows early in the analysis minimizes the risk of overstating performance indicators, making project analysis more reliable and accurate.

**Taking into account the heterogeneity of inflation in the analysis of investment projects**

**1. Inflation heterogeneity: impact and problems**

In real economic practice, the rates of income and cost inflation often differ. This is due to:

- Different elasticities of demand for raw materials, energy and services consumed by the enterprise.
- Different dynamics of consumer demand for finished products.

This heterogeneity creates an imbalance, which is especially critical for long-term investment projects. Cost growth may outpace income growth, reducing the profitability and efficiency of the project. To account for these factors, it is necessary to use methods that allow for simultaneous adjustment of cash flows and discounting taking into account inflation premiums.

**2. Formula for calculating NPV under conditions of non-uniform inflation**

To assess the effectiveness of a project, a modified formula for net present value (NPV) is used, taking into account different inflation rates for revenues ( $\pi_n$ ) and costs ( $\pi'_n$ ):

$$NPV = \sum_{t=1}^T \frac{[G_t \prod_{n=1}^t (1 + \pi_n) - C_t \prod_{n=1}^t (1 + \pi'_n)] \times (1 - \alpha) + D \times \alpha}{(1 + \bar{K})^t} - K,$$

where  $G_t$  – nominal revenue of the  $t^{th}$  year, estimated for an inflationary situation, i.e. in the prices of the base period;  $\pi_n$  – the rate of income inflation in the  $n^{th}$  year;  $C_t$  – nominal costs of the  $t^{th}$  year in the prices of the base period;  $\pi'_n$  – the rate of cost inflation in the  $n^{th}$  year;  $\alpha$  – profit tax rate;  $D$  – annual depreciation charges;  $K$  – initial project costs;  $\bar{K}$  – The “price” of capital, including the inflation premium;  $\prod$  – the multiplication sign.

Let's say that in order to analyze the efficiency of an investment project we have the following values: the initial costs of the project were 100 million units, assuming a 4-year investment period with an annual depreciation of 25 million units, while it was found that the tax rate of profit is 30%, and the cost of capital is indicated as 1116%, while the inflation premium is 1100%.

Table 2.

**Income and expenses in base period prices, million conventional units**

Years	Receipts	Cost
1	60	30
2	70	40

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3	80	40
4	80	40

Table 3.

Projected rates of revenue and cost inflation, %

Years	Income inflation rates	Cost inflation rates
1	1000	1200
2	1300	1600
3	2300	2200
4	1500	1200

Calculation:

$$NPV = \frac{[60(1+10)-30(1+12)](1-0,3)+25 \times 0,3}{1+11,16} + \frac{[70(1+10)(1+13)-40(1+12)(1+16)](1-0,3)+25 \times 0,3}{(1+11,16)^2} + \frac{[80(1+10)(1+13)(1+23)-40(1+12)(1+16)(1+22)] \times 0,7+7,5}{(1+11,16)^3} + \frac{[80 \times 11 \times 14 \times 24 \times (1+15)-40 \times 13 \times 17 \times 23 \times (1+12)] \times 0,7+7,5}{(1+11,16)^4} - 100 = 28,194;$$

The final value: NPV=28.194, which confirms the financial feasibility of the project, since NPV > 0, based on which the following conclusions can be drawn:

1. **Accounting for inflation heterogeneity:** different inflation rates for revenues and costs require the use of adjustments to accurately forecast cash flows.
2. **Applicability of the modified NPV formula:** the formula allows for simultaneous consideration of inflation adjustments and discounting based on the real «price» of capital.
3. **Practical significance:** the use of this approach reduces the risk of underestimating inflationary effects and makes the analysis of projects more accurate.

The use of a systematic approach to accounting for the heterogeneity of inflation helps to increase the accuracy of financial calculations, which is especially important in conditions of economic instability.

**Conclusion**

The conducted research emphasizes the key role of inflation in the assessment and analysis of investment projects. Inflation processes form complex challenges for financial modeling and require the use of specialized methods to ensure the accuracy of calculations and sustainability of projects. Based on the conducted analysis, the following key conclusions and recommendations can be identified.

**1. Methods for assessing inflation rates**

Forecasting inflation is a necessary element of financial analysis, as inflation significantly affects the parameters of investment projects. The use of macroeconomic indicators, such as consumer and producer price indices, money supply dynamics, and changes in supply and demand, allows for accurate forecasts.<sup>7</sup>Econometric models serve as the basis for determining annual inflation rates for the entire period of project implementation, providing a basis for correctly accounting for inflationary effects.

**2. Taking inflation into account in performance analysis**

<sup>7</sup>Mahlstedt, M., & Zagst, R. (2016). Inflation Protected Investment Strategies. Risks, 4(2), 9. <https://doi.org/10.3390/risks4020009>

Inflation changes the real value of cash flows, which requires adjusting nominal indicators and bringing them to a comparable base. To do this, it is necessary:

- Forecast nominal prices of resources and products.
- Take into account changes in the tax base.
- Determine real cash flows using deflation. These steps form the basis for calculating key performance indicators such as net present value (NPV), internal rate of return (IRR), and payback period (PP).

### 3. Analysis of efficiency under uneven inflation of income and costs

Uneven inflation affecting income and expense components can distort the results of the analysis. This is especially critical for long-term projects with a high share of borrowed capital. To neutralize such effects:

- Relative changes in prices for individual goods and services are taken into account.
- Scenario models are used to estimate a range of possible financial outcomes. These approaches minimize risks and provide more reliable results.

### 4. Accounting for inflation risks

Inflation risks are integrated into financial analysis through:

- Forecasting scenarios of changes in macroeconomic conditions.
- Calculation of real discount rates.
- Formation of hedging strategies. These measures help reduce uncertainty and strengthen the financial stability of the project in the long term.

The conducted research demonstrates that taking into account inflation effects should become an integral part of investment analysis. The use of the proposed methods, including inflation forecasting, cash flow deflation<sup>8</sup> and scenario analysis, allows to significantly increase the accuracy of assessing the effectiveness and sustainability of investment decisions.

### Recommendations

1. **Improving methodologies:** organizations and enterprises are recommended to implement adapted inflation forecasting models and integrate the accounting of inflation effects at all stages of investment analysis.
2. **Scenario modeling:** exploratory scenario approaches should be used to assess the impact of different macroeconomic conditions on revenue and expense components. This is especially important for projects with a high degree of uncertainty.
3. **Hedging inflation risks:** developing hedging strategies and using inflation protection tools (such as indexation of payments) will help reduce financial instability.

Accounting for inflation and associated risks is an important aspect of investment project management. The application of the approaches proposed in the study allows not only to increase the accuracy of the analysis, but also to ensure the sustainability of decisions in conditions of economic instability. Further research in this area should be aimed at developing more accurate and flexible models capable of taking into account both inflation and other macroeconomic factors.

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