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REAL OPTIONS APPROACH TO ASSESSING THE VALUE AND STRATEGIC EFFICIENCY OF INVESTMENT PROJECTS

Rafiyeva Zarina Xusanovna
Senior Lecturer, Department of 'Investment and Innovation',
Samarkand Institute of Economics and Service
Ashurov Akobir Makhmud ugli
Student of Samarkand institute of economics and service
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Abstract. This article explores the theoretical and methodological foundations of assessing investment project value and strategic efficiency using the real options approach. It examines the limitations of traditional net present value analysis and the economic value of opportunities to defer, expand, or abandon investments. Drawing on Uzbekistan's investment statistics and legal framework, the study proposes ways to improve investment appraisal under uncertainty.

Keywords: real options, investment projects, net present value, strategic efficiency, investment risk, capital expenditure, managerial flexibility, Uzbekistan's economy.

Annotatsiya. Maqolada real opsionlar usuli asosida investitsiya loyihalarining qiymati va strategik samaradorligini baholashning nazariy hamda metodologik jihatlari tadqiq etilgan. An'anaviy sof joriy qiymat usulining cheklovlari, investitsiyani kechiktirish, kengaytirish va loyihadan chiqish imkoniyatlarining iqtisodiy qiymati tahlil qilingan. O'zbekistonning investitsiya statistikasi va qonunchiligi asosida loyihalarni baholashni takomillashtirish yo'nalishlari asoslangan.

Kalit so'zlar: real opsionlar, investitsiya loyihasi, sof joriy qiymat, strategik samaradorlik, investitsion risk, kapital qo'yilmalar, boshqaruv moslashuvchanligi, O'zbekiston iqtisodiyoti.

Аннотация. В статье исследуются теоретические и методологические основы оценки стоимости и стратегической эффективности инвестиционных проектов на основе метода реальных опционов. Рассматриваются ограничения традиционного метода чистой приведённой стоимости, а также экономическая ценность возможностей отсрочки инвестиций, расширения проекта и выхода из него. На основе статистических данных и законодательства Узбекистана обоснованы направления совершенствования оценки инвестиционных решений.

Ключевые слова: реальные опционы, инвестиционный проект, чистая приведённая стоимость, стратегическая эффективность, инвестиционный риск, капитальные вложения, управленческая гибкость, экономика Узбекистана.

INTRODUCTION

Investment projects are undertaken in environments characterized by technological change, market fluctuations, regulatory developments, financing constraints, and uncertainty regarding future cash flows. These conditions complicate the valuation of long-term investments because the economic outcomes anticipated at the planning stage may differ substantially from those ultimately realized. Conventional investment appraisal techniques offer a systematic basis for

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comparing expected benefits with initial costs, but their effectiveness depends on the assumptions underlying projected cash flows, discount rates, and the timing of investment decisions.

Net present value (NPV) is widely recognized as a principal criterion for evaluating investment profitability. It measures the present value of expected future net cash flows less the initial investment. A positive NPV generally indicates that a project is expected to create economic value at the selected discount rate. Nevertheless, a project's value may extend beyond its forecast operating cash flows. An investor may possess the ability to postpone implementation until market conditions become clearer, expand capacity when demand increases, abandon an unsuccessful initiative, or redirect investment toward an alternative technological solution. Such managerial choices have economic value because they allow decisions to be revised as new information becomes available.

Real options theory provides a framework for incorporating these opportunities into investment valuation. Developed through the application of option-pricing principles to real assets and managerial decisions, the approach recognizes that an investment opportunity may resemble a financial option. An investor who can wait before committing capital possesses the opportunity, but not necessarily the obligation, to undertake the investment under more favourable conditions. Similarly, the ability to expand, contract, suspend, or abandon a project can reduce potential losses or increase returns when uncertainty is resolved progressively.

The distinction between financial options and real options is important. Financial options generally derive their value from traded underlying assets and contractual rights, whereas real options concern productive assets, infrastructure, technologies, natural resources, and business opportunities. Real options are often more difficult to value because their underlying assets are not continuously traded, exercise decisions may be irreversible, and the relevant uncertainty may be influenced by managerial actions, competition, and regulation.

The relevance of this approach is particularly evident in emerging economies, where investment projects may be exposed to exchange-rate movements, changes in financing conditions, infrastructure constraints, uncertain demand, and evolving institutional arrangements. Uzbekistan has experienced substantial growth in fixed capital investment, making the quality of investment appraisal increasingly important. According to the National Statistics Committee, investment in fixed capital reached UZS 363.4 trillion in 2024, with reported annual growth of 38.7%. In January–September 2025, the corresponding volume amounted to UZS 443.6 trillion, 15.2% above the same period of 2024. These figures demonstrate the scale of capital formation, although investment volume alone does not establish whether individual projects generate adequate financial or social returns.

The principal research problem is therefore how to assess investment projects not merely as fixed commitments of capital, but as strategic processes in which decision-makers can respond to changing information. This study aims to explain the theoretical foundations of real options valuation, evaluate its relationship with traditional investment appraisal, and develop an analytical approach applicable to investment projects in Uzbekistan.

LITERATURE REVIEW

The theoretical foundations of real options analysis are associated with the recognition that uncertainty and managerial flexibility can jointly influence investment value. Myers introduced the concept of growth opportunities as options in corporate valuation, demonstrating that a firm's value may depend not only on existing assets but also on future investment opportunities. This perspective challenged the assumption that the value of a company could be fully explained by the discounted cash flows of projects already undertaken.

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Dixit and Pindyck subsequently developed an extensive framework for irreversible investment under uncertainty. Their analysis showed that the decision to invest involves an opportunity cost when committing capital eliminates the possibility of waiting for additional information. Even when a project has a positive NPV under conventional assumptions, immediate investment may not be optimal if waiting has sufficient value and the opportunity can be preserved.

Trigeorgis further systematized the relationship between real options and strategic investment management. The framework identifies multiple sources of flexibility, including the option to defer, expand, contract, abandon, switch inputs or outputs, and undertake follow-on investments. These options can interact, meaning that their combined value is not always equal to the simple sum of individually estimated values. The traditional discounted cash flow method remains indispensable because it establishes a baseline estimate of project profitability. However, its standard application generally assumes that the investment strategy and operating decisions are predetermined. When management can alter these decisions in response to emerging information, a static cash flow projection may fail to capture the economic consequences of adaptation.

Real options analysis addresses this limitation by treating investment decisions as contingent on future states of the world. The value of an option depends on the investment cost, the value of the underlying opportunity, the time available before the decision must be made, uncertainty regarding future outcomes, and the conditions under which the option can be exercised. In financial option theory, volatility often increases the value of a call option because potential gains can rise while the holder can limit losses by declining to exercise. In real investment, however, this relationship is not universal: volatility may also increase financing costs, delay implementation, or expose the investor to competition and regulatory risk.

Domestic research has increasingly examined the need to improve investment project appraisal in Uzbekistan. Aliqulov's research on improving the financial analysis of investment projects discusses the use of NPV, internal rate of return, payback measures, risk analysis, Monte Carlo simulation, and real options as complementary instruments for project evaluation. This work supports the view that traditional financial measures should be integrated with methods capable of representing uncertainty more explicitly.

Xaydarov's research on the effectiveness of investment in the economy of Uzbekistan similarly examines conventional investment indicators, including NPV, internal rate of return, return on investment, and payback period, in the context of domestic investment activity. The relevance of such work lies in the need to interpret financial indicators alongside the economic and institutional characteristics of the investment environment.

A related contribution by Aytmuratova examines the integrated assessment of investment project performance in joint-stock companies and proposes combining conventional financial indicators with a broader performance index. Such approaches reinforce the argument that investment decisions require a multidimensional evaluation rather than reliance on a single profitability measure.

Despite these developments, the practical use of real options in Uzbekistan requires further methodological clarification. The existence of a theoretical option does not automatically imply that it can be exercised profitably. A postponement option may lose value when competitors can enter the market first, while an abandonment option may be limited by contractual obligations, specialised equipment, environmental requirements, or the absence of a resale market. Consequently, real options should be evaluated in connection with the project's technical, commercial, financial, and legal characteristics.

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METHODOLOGY

The study applies a conceptual and analytical research design. It combines theoretical synthesis, institutional analysis, conventional discounted cash flow valuation, and an illustrative scenario to demonstrate the implications of managerial flexibility for investment decisions.

RESULTS

The theoretical analysis indicates that real options analysis expands the conventional investment appraisal framework by incorporating the value of managerial flexibility. Under a static NPV approach, an investment project is evaluated according to expected cash flows and a selected discount rate. The decision is generally framed as acceptance or rejection at a specified point in time. By contrast, real options analysis recognises that the timing and scale of capital commitment can themselves be strategic decisions.

The first important result concerns the option to defer investment. Deferral may be valuable when market uncertainty is high and additional information is expected to improve the quality of the decision. For example, a manufacturing enterprise considering a new production line may delay installation until it obtains more reliable information about export demand, input prices, energy availability, or customer contracts. Waiting can prevent capital from being committed to an economically unattractive project. However, the option to defer is valuable only if the investor can preserve the opportunity without losing too much through competition, contractual deadlines, or market entry barriers.

The second result relates to expansion options. A project with moderate initial profitability may create access to a substantially larger market. A pilot facility, for instance, can provide technical and commercial information that supports a subsequent capacity expansion. The initial project may therefore have strategic value beyond its immediate cash flows. Conventional NPV can capture some of this value if all future expansion opportunities are explicitly included in the cash flow forecast. Real options analysis becomes particularly useful when expansion depends on information that will emerge after the initial investment.

The third result concerns abandonment and contraction options. Where a project can be discontinued or scaled down, management may limit losses when actual performance is weaker than expected. Such flexibility is relevant to projects involving new technologies, uncertain demand, or evolving production costs. Nevertheless, the value of abandonment must be reduced by closure costs, employee obligations, contractual penalties, environmental liabilities, and the difference between the asset's book value and its recoverable market value.

The hypothetical investment example illustrates the economic significance of waiting. If the enterprise invests immediately, the present value of expected operating cash flows is UZS 12 billion and the initial expenditure is UZS 10 billion. The static NPV is therefore UZS 2 billion. Under the deferral scenario, the project opportunity is worth UZS 16 billion in the favourable state and UZS 8 billion in the unfavourable state. The investor can invest only in the favourable state, when the opportunity's value exceeds the exercise cost, and decline to invest in the unfavourable state.

Discounting this expected payoff at the illustrative rate of 12% gives an option value of approximately UZS 2.68 billion. Under the deliberately simplified assumptions, the value of the opportunity to wait is therefore positive. The comparison does not imply that waiting is necessarily superior to immediate investment, because the calculation omits interim operating cash flows and other costs of delay. It demonstrates that a decision rule based solely on immediate NPV can overlook an economically meaningful source of flexibility.

The following table summarises the analytical distinction between conventional investment appraisal and real options valuation, together with their implications for project selection.

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Table 1

Comparative assessment of traditional investment appraisal and real options analysis[1]

Assessment criterion	Traditional NPV approach	Real options approach	Strategic implication
Investment timing	Usually assumes a predetermined start date	Can evaluate the value of delaying investment	Supports investment when information becomes more reliable
Uncertainty	Reflected in forecasts and discount rates	Modelled through alternative future states and contingent decisions	Makes risk-response strategies more explicit
Expansion potential	Included when future cash flows can be forecast	Treated as an opportunity conditional on future information	Helps assess projects that create growth opportunities
Downside management	Often relies on scenario and sensitivity analysis	Can value the ability to abandon, contract, or switch	Clarifies the economic benefit of limiting losses
Data requirements	Cash flows, investment cost, and discount rate	Additional assumptions concerning volatility, decision rights, timing, and exercise conditions	Requires stronger project governance and information systems
Principal limitation	May understate flexibility when decisions are treated as fixed	Can be sensitive to model assumptions and difficult-to-observe parameters	Requires transparent assumptions and validation

The comparison suggests that the two approaches should not be treated as competing alternatives. Traditional NPV provides a necessary financial baseline, while real options analysis can reveal the incremental value of contingent managerial decisions. In practice, the most defensible assessment combines both methods and makes the underlying assumptions explicit.

The macroeconomic context strengthens the relevance of this integrated approach. Uzbekistan's fixed capital investment reached UZS 363.4 trillion in 2024, corresponding to annual growth of 38.7%. During January–September 2025, the reported volume reached UZS 443.6 trillion, up 15.2% year on year. The nine-month 2025 figure exceeds the full-year 2024 amount, but this comparison must be interpreted carefully because it compares different reporting periods. It does not establish that full-year 2025 investment was lower or higher than the eventual annual total. The data nevertheless demonstrate the substantial scale of capital deployment and the need to evaluate not only the volume but also the allocation and productivity of investment.

For investors operating in Uzbekistan, the practical value of real options may vary significantly across sectors. Infrastructure and energy projects often involve substantial irreversible expenditure, long construction periods, and sensitivity to regulatory and demand

[1] Author's work

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conditions. Manufacturing projects may benefit from staged investment and modular production capacity. Digital and technology-intensive projects may be particularly suitable for pilot implementation because technical feasibility and customer adoption can be tested before a full-scale commitment. Agricultural and tourism projects may benefit from seasonal investment decisions and the opportunity to expand capacity as demand becomes more certain.

These sectoral differences imply that the choice of valuation method should be proportionate to the project's characteristics. A small project with predictable cash flows may not justify the cost of a complex option-pricing model. A large, irreversible project with substantial uncertainty and meaningful managerial flexibility, however, may warrant a more advanced analysis.

DISCUSSION

The findings support the use of real options analysis as a complement to conventional investment appraisal rather than as a replacement for established financial criteria. Positive NPV remains an important indication of expected value creation, but the decision to invest also depends on whether the opportunity can be preserved, whether uncertainty is likely to resolve over time, and whether management has genuine discretion to change the project. An essential distinction concerns uncertainty and risk. In conventional appraisal, uncertainty is often incorporated through sensitivity analysis, scenario analysis, or adjustments to the discount rate. These tools reveal how changes in key assumptions affect project profitability, but they do not necessarily capture the value of changing the investment decision after new information becomes available. Real options analysis links uncertainty to action: it asks not only how future outcomes may differ, but also how management can respond to those differences.

At the same time, the approach introduces analytical challenges. A project manager may overestimate flexibility by assuming that an expansion, abandonment, or switching decision can be implemented without additional costs. In reality, a production facility may require specialised equipment that has little resale value, and an expansion may depend on new financing, permits, or infrastructure. An option should therefore be recognised only when the relevant managerial right is economically and legally feasible. Another challenge is the estimation of volatility. Financial option models frequently use observable market prices to estimate the uncertainty of the underlying asset. Real investment opportunities often lack comparable traded assets. Analysts may need to estimate uncertainty from historical cash flows, commodity prices, exchange rates, market demand, or simulation models. These estimates can be sensitive to the selected period and the structural changes affecting the industry. Where reliable data are limited, a decision-tree approach with transparent scenario assumptions may be more defensible than an apparently precise option-pricing result.

The relationship between real options and investment strategy is also important. A project may create strategic value by generating information, establishing a distribution network, securing access to resources, or enabling entry into an adjacent market. Such benefits can be difficult to capture in a single-period profitability indicator. Nevertheless, strategic benefits should not be added mechanically to project value. Analysts must distinguish between benefits already included in projected cash flows and incremental opportunities that remain contingent on future decisions.

In Uzbekistan, the institutional framework is a central consideration. The Law of the Republic of Uzbekistan “On Investments and Investment Activities,” No. ZRU-598 of 25 December 2019, establishes the principal legal framework governing investment relations involving domestic and foreign investors. It defines investment-related concepts, addresses the rights and obligations of participants, and provides for the protection of investment activity within the scope of the legislation. The law should be considered alongside other applicable

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regulations, including rules relevant to public-private partnerships, land use, taxation, environmental requirements, licensing, and sector-specific investment arrangements.

The law does not itself prescribe a universal real options valuation model. Rather, it provides part of the institutional environment within which the feasibility of particular investment decisions must be assessed. For example, the ability to postpone a project may depend on the duration of a land-use right, a licence, an investment agreement, or a financing commitment. The option to abandon may be constrained by contractual obligations or requirements governing the restoration of a site. Consequently, financial flexibility and legal flexibility must be evaluated together. Domestic scholarship offers a useful starting point for developing this integrated approach. Research on investment project financial analysis in Uzbekistan highlights the importance of NPV, IRR, sensitivity analysis, and simulation methods. Work on investment financing and integrated project performance also draws attention to the relationship between financing structure, risk, capital allocation, and broader measures of economic effectiveness. These contributions suggest that real options analysis can be incorporated into an existing appraisal framework rather than introduced as an isolated technique.

A practical implementation framework for Uzbek enterprises should begin with a conventional financial assessment based on documented assumptions about capital expenditure, operating costs, revenue, taxes, financing, and working capital. Analysts should then identify decisions that can genuinely be postponed, expanded, reduced, switched, or abandoned. Each potential option should be linked to a decision trigger, a time limit, an implementation cost, and the information needed to exercise it. Where sufficient data are available, decision trees, binomial models, or simulation-based approaches can be used to estimate option value. The final recommendation should present the baseline NPV, the incremental value of flexibility, and the sensitivity of both measures to major assumptions.

This process can improve governance by requiring investment committees to distinguish between uncertainty that can be managed and uncertainty that cannot. It can also support staged financing, milestone-based investment, pilot projects, and periodic reassessment. However, the presence of an option should not become a justification for postponing difficult decisions indefinitely. Delay can destroy value through lost revenue, technological obsolescence, competitive entry, or increases in construction and financing costs. A sound analysis must compare the value of additional information with the cost of waiting.

The strategic efficiency of an investment project should therefore be understood more broadly than its short-term financial return. It includes the project's contribution to long-term competitiveness, its capacity to generate future opportunities, its resilience under alternative market conditions, and its compatibility with legal and institutional requirements. These dimensions do not eliminate the need for measurable financial performance; instead, they clarify how financial value can be preserved and increased over the life of the project.

CONCLUSION

Real options theory provides a valuable extension to conventional investment project appraisal because it recognises that investment decisions are often flexible, sequential, and dependent on information that becomes available over time. Traditional NPV remains essential for establishing the expected financial value of a project, but it may provide an incomplete picture when managerial decisions can materially alter future investment costs, operating strategies, or project scale.

The analysis demonstrates that the option to defer investment can possess positive economic value when the investor can avoid unfavourable outcomes while retaining the opportunity to invest under more attractive conditions. Expansion, contraction, abandonment, and technological

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switching may also create value when they are feasible and not already incorporated into baseline cash flow forecasts. Nevertheless, option value is not automatic: it depends on the quality of information, the irreversibility of capital expenditure, competitive conditions, financing constraints, and legal rights. Uzbekistan's investment statistics indicate substantial capital formation, while the national legal framework provides an institutional foundation for investment activity. These conditions reinforce the importance of improving the quality of project selection and the transparency of investment decisions. For domestic enterprises, a combined appraisal system based on NPV, scenario analysis, risk assessment, and real options can support more adaptive capital allocation and better strategic planning.

The principal methodological recommendation is to treat real options as a structured supplement to traditional financial analysis. Enterprises should identify genuine decision rights, define measurable exercise conditions, estimate the costs of flexibility, and report the incremental option value separately from the baseline NPV. Public institutions and research organisations can support wider application by improving project-level data availability, developing sector-specific valuation guidance, and expanding training in uncertainty analysis and investment modelling.

The study is limited by its conceptual design and illustrative numerical example. Its results should not be interpreted as an empirical estimate of the average value created by real options in Uzbekistan. Further research should examine actual investment projects across manufacturing, energy, infrastructure, agriculture, and tourism, using observed cash flows, investment timing, market uncertainty, and realised project outcomes. Such research could establish which types of projects benefit most from real options analysis and identify the conditions under which managerial flexibility produces measurable improvements in investment performance.

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