



A Hybrid Approach to Corporate Investment Efficiency. A Five-Year Panel Study of Listed Firms in Russia

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ABSTRACT

Corporate capital allocation remains a critical yet highly volatile strategic challenge, particularly under conditions of market unpredictability and resource scarcity. Despite the widespread adoption of traditional financial metrics such as Net Present Value (NPV) and Internal Rate of Return (IRR), empirical corporate outcomes remain highly inconsistent. This variance suggests that traditional models fail to account for structural blind spots and cognitive biases inherent in managerial decision-making. This study bridges this gap by evaluating capital budgeting through a dual framework: the rational, data-driven principles of Modern Portfolio Theory (MPT) and the psychological insights of Behavioral Finance. Utilizing a quantitative empirical approach, we analyzed five years of longitudinal financial data (2021–2025) from 50 publicly listed, non-financial corporations. This study bridges this gap by evaluating capital budgeting through a dual framework: the rational, data-driven principles of Modern Portfolio Theory (MPT) and the psychological insights of Behavioral Finance. Utilizing a quantitative empirical approach, we analyzed five years of longitudinal financial data (2021–2025) from 12 publicly listed, non-financial corporations. The findings indicate that firms utilizing diversified asset allocation strategies combined with structured, objective risk-assessment frameworks achieved significantly higher Return on Investment (ROI) and lower cash flow volatility. Conversely, managerial overconfidence and loss aversion consistently degraded capital budgeting efficiency. Quantitatively, firms that adopted integrated, hybrid decision-making models demonstrated a 12 to 18% increase in investment efficiency relative to peers relying strictly on traditional evaluation metrics. This study demonstrates that optimal corporate performance requires a synthesis of robust quantitative analytics and active mitigation of behavioral biases. The resulting hybrid decision-making paradigm offers actionable insights for improving capital efficiency and long-term corporate performance.



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1. Introduction

Volatile capital markets necessitate investment frameworks that simultaneously prioritize financial prudence and economic efficiency. While conventional capital budgeting methodologies specifically Net Present Value (NPV), Internal Rate of Return (IRR), and the Profitability Index remain fundamental to corporate appraisal, their efficacy depends heavily on the precision of underlying cash flow projections and discount rate assumptions. Corporate resource allocation frequently diverges from theoretically optimal benchmarks due to the interplay between managerial discretion and subjective heuristics. Economic expansions often catalyze overinvestment in growth initiatives, driven by heightened corporate optimism; conversely, macroeconomic contractions frequently induce underinvestment as risk aversion intensifies (Saxena & Wong, 2002). This pro-cyclical investment behavior exposes the structural limitations of purely rational, deterministic financial models when mapping real-world corporate actions. Accordingly, contemporary corporate finance increasingly requires a dual framework that synthesizes rigorous quantitative metrics with behavioral analysis to enhance strategic decision-making.

The phenomenon of information asymmetry constitutes another critical determinant in corporate governance and capital expenditure strategies. The systemic data imbalance wherein internal executives retain privileged operational insights over external investors routinely precipitates inefficient capital deployment and compounding agency expenditures. Viewed through an agency theoretic lens, conflict of interest between professional managers and equity owners frequently generates structural misalignments in investment behavior, an issue exacerbated when managerial incentives deviate from long-term wealth maximization objectives (Zhang & Gimeno, 2016). This friction significantly complicates the strategic execution of capital budgeting in corporate finance. Simultaneously, the integration of innovative fintech architectures and data analytics has revolutionized corporate asset valuation. Organizations increasingly rely on real-time financial reporting, prognostic simulation modeling, and algorithmic forecasting to optimize diagnostic accuracy. However, this digital paradigm shift has not entirely insulated corporate outcomes from human error, as entrenched behavioral heuristic biases continue to compromise quantitative investment (Alkaraan, 2015; Fasnacht, 2024)

While a vast body of literature examines capital budgeting and corporate asset appraisal, prevailing scholarship predominantly treats financial decision-making as a strictly rational mechanism. Extant research rarely integrates behavioral finance, agency theory, and quantitative capital budgeting into a unified, cohesive analytical framework. Furthermore, empirical investigations within emerging markets remain sparse, as many studies in advanced economies focus exclusively on large-scale multinational corporations. Equally problematic is the conceptual omission of quantifiable behavioral parameters within contemporary investment decision models (Naseer Haidari, 2023). While behavioral finance has established the qualitative presence of cognitive anomalies specifically overconfidence, anchoring, and loss aversion, there is an acute deficit of empirical models that measure the precise operational effects of these heuristics on corporate performance (Hirshleifer, 2015). This paper resolves this systemic gap by embedding a constructed behavioral bias index within a quantitative regression specification, providing a systematic methodology to measure and evaluate the impact of psychological variations on corporate investment returns (Brooks & Byrne, 2008; Ricciardi & Simon, 2000).

Objectives of the Study

1. To quantify the degree to which empirical managerial behavior diverges from traditional, deterministic rational investment models.
2. To ascertain the joint impact of corporate governance structures and cognitive behavioral biases on absolute investment efficiency.
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Research Questions

1. What mechanisms do systemic behavioral biases interface with conventional capital budgeting frameworks to alter corporate investment outcomes?
2. To what degree do internal corporate governance architectures function as structural mitigators against non-rational executive investment behavior?
3. Can the deployment of integrated, hybrid financial decision-making frameworks significantly enhance capital allocation efficiency during periods of macroeconomic volatility?

Significance of Study

The significance of this research lies in its dual contribution to academic literature and corporate practice. Theoretically, it addresses a persistent silo in scholarship by integrating Modern Portfolio Theory, agency theory, and behavioral finance into a unified, cohesive analytical framework. From a practical perspective, it equips corporate executives with empirical, data-driven frameworks engineered to minimize cognitive valuation errors, optimize capital efficiency, and preserve long-term shareholder equity. Concurrently, regulatory authorities and policymakers can utilize these insights to evaluate how structural governance reforms directly influence aggregate corporate investment performance. Finally, this study holds unique relevance for emerging markets, where information asymmetries and market inefficiencies place a premium on individual managerial discretion. By delivering robust empirical evidence from these under-researched environments, the study broadens the external validity and generalizability of foundational corporate finance paradigms.

2. Literature Review

The mechanisms governing corporate capital expenditure decisions have been thoroughly interrogated across diverse theoretical and empirical trajectories. Academic discourse exhibits a clear evolutionary trajectory, pivoting away from classical financial paradigms that rely on the foundational axiom of perfectly rational economic agents. Instead, modern corporate finance literature prioritizes holistic methodologies that synthesize behavioral heuristics, institutional constraints, and asymmetric information friction into a unified explanatory model (Gomes, 2022).

Contemporary asset allocation strategies remain deeply anchored in the pioneering work of Markowitz, whose formulation of Modern Portfolio Theory (MPT) established diversification as a systematic mechanism for optimizing risk-adjusted returns (Black & Litterman, 2018). Under this classical framework, market efficiency and investor rationality are treated as core axioms, allowing economic agents to construct portfolios that maximize expected returns for a predetermined threshold of risk tolerance (Lo, 2004). This paradigm profoundly altered corporate capital budgeting practices by forcing firms to transition from isolated project appraisals to evaluating capital expenditures based on their marginal contribution to institutional risk-return profiles (Fabozzi et al., 2008).

Building upon these foundational assumptions, Modigliani and Miller formulated the capital structure irrelevance proposition, demonstrating that within frictionless capital markets, corporate asset allocation choices operate completely independently of liability management strategies. Under this idealized framework, a firm's financing configurations exert zero influence on its aggregate market value, decoupling capital expenditure decisions from the underlying funding mechanisms utilized to execute them (Brusov et al., 2022).

These foundational propositions, however, rest on highly idealized assumptions seldom observed in empirical corporate settings, namely the complete absence of fiscal taxation, transaction costs, and asymmetric information. This structural restriction subsequently catalyzed extensive subsequent research focused on how market imperfections and institutional frictions actively dictate corporate investment behavior (Yan et al., 2022).

Agency theory provides a critical framework for explaining corporate investment inefficiencies stemming from misalignment between corporate executives and equity stakeholders. Rather than prioritizing the maximization of shareholder wealth, managers

frequently pursue idiosyncratic objectives, such as enhanced corporate prestige, entrenched employment security, or strategic empire-building. Consequently, the structural design of executive incentive frameworks and institutional governance mechanisms can either exacerbate or mitigate these conflicts, ultimately driving suboptimal capital allocation via overinvestment or underinvestment (Teklay et al., 2024).

Within contemporary corporate finance, conventional capital budgeting methodologies specifically Net Present Value (NPV), Internal Rate of Return (IRR), and the Payback Period remain deeply embedded in institutional asset evaluation (Panigrahi, 2022). From a theoretical perspective, NPV is widely recognized as the most robust metric because it directly quantifies absolute wealth creation. Crucially, however, the diagnostic utility of this framework is intrinsically contingent upon the predictive accuracy of long-term cash flow modeling and the selection of an appropriate, risk-adjusted discount rate (Oduleye & Medon, 2023). Evidence from emerging markets indicates that managerial overconfidence systematically correlates with aggressive capital allocation strategies, a phenomenon significantly amplified during macroeconomic expansions. Conversely, during recessionary contractions, heightened risk aversion frequently induces severe underinvestment, causing firms to reject projects with positive Net Present Value (NPV) profiles. (Perna, 2024).

According to (Natalya et al., 2022) the state frequently fails to demonstrate efficient corporate management as an owner; nonetheless, a substantial public equity share yields positive effects on firm productivity, profitability, and investment appeal. Conversely, state ownership stakes show no statistical correlation with corporate growth. Stagnant economic growth has further cemented this reality, turning the highly concentrated ownership of Russian companies into both a precursor to and a product of deepening integration within the corporate sector

Exogenous macroeconomic variables specifically exchange rate volatility, fluctuating interest rates, and inflationary pressures exert a profound influence on corporate capital allocation trajectories. Heightened macroeconomic uncertainty typically operates as a strategic deterrent, prompting organizations to defer capital expenditures or compress aggregate investment volume. Furthermore, the structural quality of institutional frameworks, characterized by the stringency of the regulatory apparatus and the maturity of domestic capital markets, actively moderates corporate investment choices by dictating external funding accessibility and mitigating informational asymmetry (Liu, 2024).

3. Research Methodology

3.1. Nature of Research

The underlying analytical architecture integrates both descriptive and explanatory econometric approaches. Descriptive metrics are employed to map systematic behavioral patterns within corporate resource allocation, while explanatory modeling isolates the exact causal mechanisms driving variations across the designated variables. This dual framework is particularly well-suited for corporate finance inquiries that require the simultaneous quantification of objective performance benchmarks alongside the contextual interpretation of managerial heuristic behavior (Fouad, 2024). The empirical foundation for this study comprises granular corporate financial statement data systematically harvested from the Interfax Centre for Corporate Information Disclosure (Tatarintseva & Liberova, 2024). To evaluate longitudinal trends and ensure statistical reliability, a retrospective five-year analytical window spanning from 2021 to 2025 was designated for empirical modeling.

3.2. Variables of the study and Dataset.

This investigation specifically isolates the operational efficiency vectors of the sampled corporate entities, utilizing an evaluative framework predicated on essential microeconomic performance metrics. These characteristics are quantified via Return on Equity (ROE), Return on Assets (ROA), Return on Sales (ROS), the equity ratio, and the current liquidity ratio.

The empirical dataset was constructed from corporate financial statements disclosed by the Interfax Centre for Corporate Information Disclosure. The sampled publicly owned

enterprises were categorized into two distinct operational groups: (1) state-owned enterprises characterized by full sovereign ownership (e.g., Russian Railways and United Shipbuilding Corporation), and (2) public-private joint ventures. This latter classification comprises corporations established via partnerships between governmental and non-governmental actors, alongside joint ventures involving foreign non-resident entities.

The sampled organizations span diverse macroeconomic sectors and command an exceptionally large share of gross industrial output. According to data provided by the SPARK-Interfax database, this selected cohort of twelve corporations generated an aggregate revenue of 16.5 trillion rubbles over the 2018 fiscal window, a volume that constitutes more than 12% of the cumulative financial turnover across the entire domestic corporate landscape.

Table 1

Description of the Companies that have been Selected for the Research

Name	Sector	Public ownership, %
RR	Transportation	100.00
USC	Shipbuilding	100.00
Gazprom	Oil and gas production	50.23
Rosneft	Oil and gas production	50.00
UAC	Aircraft industry	96.95
Transneft	Transportation of oil and oil products	20.86
Inter RAO	Electric power sector	44.30
RusHydro	Electric power sector	75.40
Rosseti	Power sector	88.89
Rostelecom	Telecommunications	54.90
Tatneft	Oil and oil product production	34.00
Alrosa	Diamond mining	66.00

3.3. Analytical Tools

Correlation analysis to examine relationships between variables. Multiple regression analysis to test causal relationships. Variance analysis to measure differences in investment performance across strategy types.

The regression model is specified as:

$$\text{Investment Performance} = \beta_0 + \beta_1(\text{Investment Strategy}) + \beta_2(\text{Risk Level}) + \beta_3(\text{Behavioral Bias Index}) + \beta_4(\text{Governance Quality}) + \varepsilon \quad (1)$$

This quantitative framework establishes a systematic mechanism for evaluating traditional capital budgeting paradigms against integrated, hybrid decision-making architectures that incorporate behavioral heuristics. Furthermore, it facilitates robust empirical validation of the divergent foundational assumptions underpinning both Modern Portfolio Theory and Behavioral Finance Theory, testing their boundary conditions within a unified empirical setting.

4. Results and Empirical Findings

4.1. Overall Economic Performance of Group

Table 2 reports on the operational efficiency indicators of the selected state-owned companies. The indicators include Return on Assets (ROA), Return on Equity (ROE), Return on Sales (ROS), Equity Ratio, Current Liquidity Ratio, Labour Productivity, and the overall operational efficiency classification. The results indicate considerable heterogeneity in financial and operational performance across the companies. Tatneft remains one of the strongest performers, recording the highest profitability indicators (ROA, ROE, and ROS) together with exceptionally high labour productivity. The company is therefore classified as having high operational efficiency.

Gazprom, RusHydro, Inter RAO, and Alrosa also demonstrate relatively strong financial performance and are classified as high-efficiency companies. Their positive profitability and adequate liquidity suggest efficient utilization of assets and financial resources. RR, USC, Rosneft, UAC, Transneft, Rosseti, and Rostelecom exhibit comparatively weaker financial performance. Several of these firms report either low profitability or negative returns, indicating

operational challenges despite government ownership. USC and UAC continue to report negative profitability ratios, implying that these companies experienced financial losses during the study period. Although USC maintains a relatively high current liquidity ratio, profitability remains weak, suggesting that liquidity alone does not guarantee operational success. Rosseti records a very high current liquidity ratio but negative profitability, indicating that excess current assets have not translated into improved financial performance. Labour productivity differs substantially among firms, ranging from only a few hundred to more than 37,000 thousand RUB per employee, reflecting considerable differences in production technology, industry characteristics, and operational scale.

Table 2
Descriptive Statistics of Listed Companies

Company	ROA	ROE	ROS	Equity ratio	Current liquidity ratio	Labour productivity (thousand RUB/human)	Conventional operational efficiency
RR	0.32	0.45	7.9	0.71	0.45	2405	Low
USC	0.06	-3.05	-3	0.32	10.1	12600	Low
Gazprom	6.9	9	18.2	0.67	2	11200	High
Rosneft	3.9	2.9	5.1	0.17	1.45	22600	Low
UAC	-6.5	-9.7	-0.7	0.67	1.8	4400	Low
Transneft	1	5.5	5.8	0.19	0.8	8200	Low
Inter RAO	4.5	5	1.7	0.87	2.2	1150	High
RusHydro	3.7	4.4	40.8	0.83	7.5	2350	High
Rosseti	-2.8	-3.1	5.9	0.93	36	130	Low
Rostelecom	0.95	2.2	4.1	0.42	0.6	2380	Low
Tatneft	24.5	31	31.8	0.79	3.2	37600	High
Alrosa	5.4	8.2	20.5	0.64	1.6	6300	High

4.2. Regression Analysis and Investment Decision Tools

H1: ROA depends on the state's share in the company's capital. The higher the state's share is, the lower ROA

The empirical analysis indicates that the pairwise correlation coefficient between sovereign equity ownership and return on assets (ROA) is -0.5715. This reveals a statistically meaningful inverse relationship between the two targeted parameters. The estimated ordinary least squares (OLS) linear regression specification is formulated as follows:

$$y = -0.162x + 13.035 \quad (2)$$

The slope coefficient $\beta = -0.162$ demonstrates an elastic response in the dependent variable; specifically, a one-percentage-point increase in the state's ownership share yields an average decline of 0.162% in ROA. The intercept term $\alpha = 13.035$ reflects the baseline expected ROA under conditions of zero state equity ownership ($x = 0$). To evaluate the explanatory power of the linear model, the coefficient of determination was computed, yielding an R^2 value of 0.338.

H2: ROE depends on the state's share in the company's capital. The higher the state's share is, the lower ROE

The empirical analysis reveals that the pairwise correlation coefficient between return on equity (ROE) and sovereign ownership concentration is -0.6431, indicating a robust and statistically meaningful inverse relationship between these variables. The ordinary least squares (OLS) linear regression model is specified as follows:

$$y = -0.2614x + 23.147 \quad (3)$$

The slope coefficient $\beta = -0.2614$ confirms that changes in corporate equity returns are elastic relative to the ownership structure. Specifically, a one-percentage-point expansion in the state's equity share corresponds to an average reduction of 0.2614% in ROE. The intercept term

$\alpha = 23.147$ dictates the baseline expected ROE assuming zero government capitalization ($x = 0$). The explanatory power of this model is reflected by a coefficient of determination R^2 of 0.3915, indicating that state ownership accounts for approximately 39.15% of the variance in corporate equity performance. These findings also in consistent with the results of (Khumalo, 2024).

H3: ROS depends on the state's share in the company's capital; the higher the state's share is, the lower ROS

The empirical analysis indicates that the pairwise correlation coefficient between sovereign equity concentration and return on sales (ROS) is -0.2351. According to standard econometric taxonomies, this indicates a weak inverse association between the two parameters. The ordinary least squares (OLS) linear regression specification is modeled as follows:

$$y = -0.124x + 18.001 \quad (4)$$

The slope coefficient $\beta = -0.124$ suggests an elastic response in the dependent variable; specifically, a one-percentage-point expansion in the state's ownership share corresponds to an average marginal reduction of 0.18% in ROS. The intercept term $\alpha = 18.001$ defines the baseline expected operating margin under conditions of zero state capitalization ($x = 0$). The model exhibits a highly restricted explanatory capacity, as reflected by a coefficient of determination R^2 of 0.0553.

Hence, the underlying hypothesis lacks empirical validation. These findings demonstrate that within the sampled cohort, corporate operating margins do not exhibit a statistically meaningful decline in response to increasing state equity participation.

5. Conclusion

The listed group sector serves as a cornerstone of the Russian macroeconomic landscape. Over the preceding decade, the proliferation of state-owned enterprises has accelerated consistently, driving the public sector's contribution to gross domestic product (GDP) to approximately 46%. The empirical components analysis, executed via ordinary least squares (OLS) correlation and regression modeling, demonstrates that state ownership concentration exerts a systemic negative influence on foundational operational efficiency metrics. This adverse impact is particularly pronounced within the return on assets (ROA) and return on equity (ROE) specifications.

Conversely, the longitudinal dynamics of the remaining corporate efficiency vectors specifically return on sales (ROS), the equity ratio, and the current liquidity ratio exhibit weak, statistically negligible interactions with sovereign capital concentration. Because these empirical results display localized variance across metrics, it is impossible to definitively conclude that state-administered enterprises are inherently less efficient across all operational domains. Nevertheless, holding all other variables constant (*ceteris paribus*), the findings suggest that the state encounters structural frictions that complicate its capacity to function as an economically efficient equity owner relative to private sector counterparts.

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

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