# Modeling and Prioritizing Financing Methods for Different Economic Sectors in Iran Using a Multi-Criteria Decision-Making Approach (ANP-TOPSIS)

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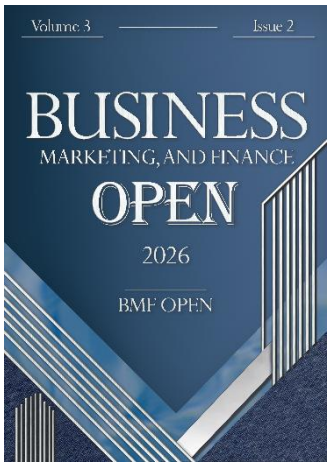


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**Abstract:** This study aimed to develop a structured decision-making model to evaluate and prioritize financing methods for different economic sectors in Iran, with a particular focus on the National Iranian Gas Company (NIGC). This applied research used a descriptive-analytical design integrating the Analytic Network Process (ANP) and the TOPSIS techniques. Financial statements from 20 NIGC subsidiaries over five years were analyzed to identify key criteria influencing financing method selection, including bankruptcy risk, cost of financing, expected debt ratio, interest rate, and degree of corporate control. Data were collected from 20 financial experts using a researcher-developed questionnaire and semi-structured interviews. Expert judgments were aggregated using the geometric mean and analyzed through pairwise comparisons in the ANP framework. The TOPSIS technique was employed to model interrelations among criteria, and the ANP supermatrix was used to derive the final weights and rankings of criteria and financing alternatives. The results revealed that bankruptcy risk, cost of financing, and expected debt ratio were the most influential criteria shaping financing decisions, while tax advantage and earnings per share had minimal influence. Among financing options, inter-unit loans received the highest priority, followed by capital increases from the parent company, whereas bank loans ranked lowest. Validation analysis showed that applying the proposed model reduced the weighted average cost of capital (WACC) in 10 out of 13 subsidiaries, indicating its effectiveness in lowering financing costs and improving capital allocation efficiency. The proposed ANP-TOPSIS model offers a robust and structured framework for optimizing financing strategies, enabling organizations to minimize capital costs, enhance financial resilience, and reduce reliance on costly external borrowing.

**Keywords:** Financing methods; Analytic Network Process; TOPSIS; multi-criteria decision-making; bankruptcy risk; cost of capital; inter-unit loans

## 1. Introduction

In recent years, the dynamics of banking and financial systems have undergone significant transformation, prompting an urgent need to reconsider the strategies and structures that govern financing decisions across various economic sectors. Access to adequate financing is one of the most critical determinants of corporate performance, risk resilience, and long-term sustainability. Particularly in emerging economies such as Iran, where financial markets are traditionally bank-dominated, optimizing financing mechanisms is essential for enhancing operational

efficiency and ensuring the continuity of strategic investments. The evolving financial landscape—shaped by globalization, technological innovation, regulatory reforms, and the growing importance of sustainability—has added layers of complexity to financing decisions, compelling both financial institutions and corporations to adopt more structured and data-driven approaches to funding allocation and risk management.

A central aspect of this evolving landscape is the diversification of financing instruments and sources. Conventional bank-based financing has historically been the dominant model in many developing economies, but its limitations, such as high interest costs, credit rationing, and procyclicality, have spurred interest in alternative financing channels, including capital market instruments, risk-sharing contracts, and internal capital markets within conglomerates. The shift toward diversified funding structures aligns with empirical evidence indicating that over-reliance on a single source of financing can expose firms to systemic shocks, liquidity constraints, and increased financial vulnerability [1-3]. Studies show that financial institutions with more balanced funding portfolios exhibit greater resilience during macroeconomic disturbances, as they can strategically substitute between external borrowing and internal funding mechanisms [4, 5].

Another dimension shaping financing decisions is the quality and structure of bank assets. Asset quality not only influences the cost of capital but also affects regulatory capital requirements and risk-weighted exposures, thereby altering the attractiveness of different funding channels [3]. Evidence from European banking systems indicates that after the implementation of bail-in regimes and the removal of implicit government guarantees, banks have shifted their strategies toward safer and more stable funding sources such as retail deposits while reducing reliance on riskier instruments like wholesale bonds [2]. This suggests that regulatory reforms can significantly reshape the funding preferences of banks and, by extension, influence the financing environment of corporate borrowers. Similarly, the integration of macroprudential measures has been shown to lower bank funding costs, particularly in developed markets, by mitigating systemic risk and enhancing financial stability [5].

In the context of Islamic banking, which constitutes a growing share of the financial system in Iran and other Muslim-majority countries, distinctive financing instruments based on risk-sharing principles—such as Musharaka, Mudarabah, and Istijrar—play a vital role. These instruments offer alternatives to conventional debt-based financing and can enhance financial stability by aligning the interests of financiers and entrepreneurs. Research shows that risk-sharing contracts like Musharaka tend to strengthen the stability of Islamic banks, while Mudarabah may reduce stability if institutional quality is weak, though it becomes stabilizing when institutional quality is high [6]. Other studies suggest that achieving a stable equilibrium in Musharaka markets requires elastic demand and relatively inelastic supply, a condition not always present in current Islamic banking structures [7]. Moreover, innovative contracts such as Istijrar have been proposed to address operational inefficiencies and compliance issues associated with murabaha financing, offering simplified documentation and lower transaction costs [8].

Within Iran, the mobilization of banking resources through Islamic financing has been identified as a crucial strategy to enhance capital formation and support the broader economy [9]. However, empirical evidence also shows that Islamic financial instruments, such as Sukuk, can increase banks' risk-taking tendencies, particularly in environments characterized by high inflation and state ownership, while macroeconomic growth indicators tend to reduce credit risk [10]. This suggests that the effectiveness of Islamic financing mechanisms depends on macroeconomic stability and the design of institutional frameworks that manage risk exposures. In addition, organizational and human resource factors within banks—such as staff competency, screening quality, and risk assessment practices—have been shown to strongly influence the quality of profit-and-loss sharing (PLS) financing

[11]. Strengthening these internal capabilities is therefore a prerequisite for scaling up risk-sharing financing mechanisms in Islamic banks.

Recent literature has also emphasized the growing influence of technological innovation and sustainability considerations in shaping financing and funding decisions. The rise of financial technology (fintech) has transformed the operational models of banks, improving efficiency, transparency, and customer engagement while simultaneously reshaping market discipline and competitive dynamics [12, 13]. In parallel, digital banking platforms are expanding financial inclusion and reshaping customer behavior, particularly in emerging markets, by lowering transaction costs and providing more convenient access to credit and savings products [14, 15]. These digital channels not only broaden the resource base available to banks but also enable more granular risk assessment and real-time liquidity management, which can influence the availability and pricing of credit. From a strategic perspective, digitalization allows banks to diversify their funding mix and reduce dependency on traditional, interest-sensitive sources [4].

Sustainability-related imperatives have also become central to the evolution of banking and financing practices. Banks are increasingly integrating environmental, social, and governance (ESG) criteria into their funding strategies, both to comply with regulatory expectations and to enhance their reputational standing [16]. Green banking initiatives—such as green credit lines, sustainability-linked bonds, and environmental risk assessment protocols—are being adopted to align financing activities with climate and environmental goals [17, 18]. These initiatives not only improve the environmental performance and corporate image of banks but also open access to specialized funding pools and concessional capital. Evidence suggests that customers are more loyal to banks that adopt green and socially responsible practices, making ESG integration a competitive necessity in addition to a regulatory requirement [19]. This trend has profound implications for firms seeking external financing, as banks increasingly factor ESG performance into their credit risk assessments and pricing decisions.

Despite these advances, financing in Iran remains predominantly bank-based, and the capital market is still underdeveloped relative to global benchmarks. This structural imbalance places excessive pressure on the banking system, which must intermediate both short-term liquidity needs and long-term investment financing. Banks often face liquidity mismatches and high funding costs, limiting their ability to support large-scale industrial and infrastructure projects. Moreover, the concentration of financing flows through banks amplifies systemic risks, as shocks to the banking sector can rapidly transmit to the broader economy. Scholars have argued that diversifying the sources of financing and strengthening the internal capital markets of conglomerates can alleviate this pressure, improve capital allocation efficiency, and reduce overall financing costs [1, 2].

Against this backdrop, the present study seeks to develop a structured decision-making model to evaluate and prioritize financing methods for different economic sectors in Iran, with a specific focus on the National Iranian Gas Company. By integrating the TOPSIS technique with the ANP approach, this study aims to identify the most effective financing strategies based on a comprehensive set of criteria, including cost of capital, bankruptcy risk, expected debt ratio, cash flow considerations, and corporate control implications. This approach addresses several gaps in the literature. First, while prior studies have analyzed individual financing instruments or market segments, few have offered a holistic, multi-criteria model that integrates both internal and external financing options within a unified decision framework [20]. Second, the study responds to calls for incorporating institutional and organizational dimensions into financing models, recognizing that the success of any funding strategy depends not only on market conditions but also on internal governance and risk management capacities [6, 11]. Third, by

applying the model to a large multi-subsidiary organization, the study explores the potential for inter-unit loans as a cost-effective internal financing mechanism—an area that remains underexplored in the context of Iran [9].

In sum, the study contributes to the broader discourse on financial optimization in emerging economies by offering an evidence-based framework for selecting financing methods that align with organizational goals, regulatory constraints, and market realities. The outcomes are expected to support financial managers in reducing the weighted average cost of capital, enhancing financial flexibility, and mitigating risk exposure, thereby promoting more sustainable economic growth. By addressing both strategic and operational aspects of financing, this research provides practical insights for policymakers, regulators, and corporate decision-makers seeking to strengthen the resilience and efficiency of the Iranian financial system.

## 2. Methodology

The study adopted an applied research design with a descriptive-analytical approach. It combined qualitative and quantitative data to develop a structured decision-making framework. The process began with a comprehensive review of the literature and a detailed analysis of the financial statements of the NIGC over a five-year period. This initial phase identified key criteria that influence the selection of financing methods, which were then validated and refined through consultation with financial experts.

The statistical population consisted of experts, senior managers, and informed staff from the financial departments of the NIGC and its affiliated subsidiaries. To be included, experts had to meet the following conditions:

1. Have direct professional experience in financial management or corporate financing,
2. Possess at least five years of relevant work experience, and
3. Be directly involved in financing decisions or analysis.

Based on the Cochran formula and the limited size of the expert population, the total sample size was determined to be 20 individuals. Because the population was small, a census method was used, and all 20 eligible experts participated in the study.

Two sources of data were used. First, financial statements (including balance sheets and income statements) from 20 subsidiaries of the NIGC over a five-year period were collected to extract the required financial parameters for the decision model. Second, a researcher-developed questionnaire was designed to gather expert judgments for the multi-criteria decision-making analysis. The questionnaire included pairwise comparisons of criteria and alternatives for the ANP model and ratings of interrelationships for the TOPSIS analysis.

Additional semi-structured interviews were conducted with selected experts to ensure that the list of criteria was comprehensive and valid. This triangulation of documentary data, surveys, and interviews enhanced the credibility and robustness of the data set.

The data analysis was carried out in several sequential steps:

**Step 1: Building the Direct-Relation Matrix (TOPSIS stage).**

The responses from all expert questionnaires were aggregated using the simple arithmetic mean to build a direct-relation matrix (M). This matrix represented the mutual influence among the identified criteria. The matrix was normalized using the equation $N = K \times M$, where K is the reciprocal of the largest row or column sum in M. The normalized matrix was used to compute the total-relation matrix (T). The sums of the rows (D) and columns (R) of T were calculated to measure the degree of influence (D) and the degree of being influenced (R) for each criterion.

The values of D+R showed the overall interaction level, and the values of D−R revealed whether each criterion acted as a cause (positive) or an effect (negative).

**Step 2: Building the Network Relation Map (NRM).**

The average of all elements in matrix T was calculated as the threshold value. Relationships with values lower than the threshold were removed to filter out weak or insignificant interactions. This ensured that only strong, meaningful links remained in the network model.

**Step 3: Applying the ANP Technique.**

The filtered network of criteria was analyzed using the ANP method to calculate the relative weights of each criterion and financing alternative. Pairwise comparison judgments were collected from the experts and aggregated using the geometric mean method. These judgments were used to construct the unweighted supermatrix, which contained all local priority values between criteria. The supermatrix was then weighted by multiplying each block by the corresponding cluster weight to create the weighted supermatrix. Finally, the weighted supermatrix was raised to successive powers until convergence was achieved, resulting in the limiting supermatrix that contained the global priority weights of all criteria and alternatives.

**Step 4: Ranking of Criteria and Financing Methods.**

The priority weights of the criteria and financing options were extracted from the limiting supermatrix. The financing alternatives considered in this study were: (1) bank loans, (2) inter-unit loans, and (3) capital increase from the parent company. Their relative priorities were compared based on the weighted importance of the criteria.

The data preprocessing, normalization, and extraction of financial variables were performed using Microsoft Excel. The ANP analysis, including pairwise comparisons and supermatrix computations, was carried out using Super Decisions. The final optimization calculations and consistency checks were performed using MATLAB to ensure numerical accuracy and convergence of the model.

To ensure validity, the initial list of criteria was derived from a comprehensive literature review and refined through interviews with domain experts. The questionnaire was reviewed by a panel of academic and industry specialists for content validity. The consistency ratio (CR) of the pairwise comparisons was calculated and was below 0.1, which indicates acceptable consistency and reliability in the experts' judgments. This confirmed the internal validity and logical coherence of the ANP decision model.

## 3. Findings and Results

This section presents the results of the multi-criteria decision-making analysis used to model and prioritize financing methods for different economic sectors in Iran, with a focus on the National Iranian Gas Company. Data were extracted from the financial statements of 20 affiliated subsidiaries and analyzed using the TOPSIS and Analytic Network Process (ANP) techniques. The analysis involved forming and normalizing a direct-relation matrix, identifying the causal roles of criteria, and filtering meaningful relationships using a threshold value to construct the network relation map (NRM).

The first step involved collecting the completed questionnaires from 20 financial experts and aggregating their responses to build a direct-relation matrix (M) representing the mutual influence among the criteria. The responses were averaged to create a single collective matrix.

This matrix was then normalized using the formula $N = K \times M$, where K was calculated as the reciprocal of the largest row or column sum in the matrix. The normalized direct-relation matrix was then used to compute the total-relation matrix T. From matrix T, the sum of each row (D) and each column (R) was calculated. The value of D + R

shows the overall interaction of each criterion with all other criteria, and the value of D - R indicates whether a criterion mainly acts as a cause (positive value) or an effect (negative value).

Table 1 shows the computed D + R (X) and D - R (Y) values for each criterion.

**Table 1. Coordinates of Criteria Based on D+R and D−R Analysis**

| Criterion | Symbol | D+R (X) | D−R (Y) |
|---|---|---|---|
| Tax Advantage | A | 6.5854 | 0.5156 |
| Cost of Financing | B | 8.7383 | 0.4548 |
| Bankruptcy Risk | C | 9.1684 | 0.5474 |
| Earnings per Share | D | 8.0883 | 0.4043 |
| Post-Financing Value | E | 7.1011 | -0.2813 |
| Expected Debt Ratio | F | 8.3852 | -0.3267 |
| Financial Flexibility | G | 8.1309 | -0.5579 |
| Interest Rate | H | 8.6055 | 0.4636 |
| Cash Flows | I | 8.4627 | -0.8978 |
| Degree of Company Control | J | 4.9713 | -0.3220 |

The results showed that several criteria had positive D−R values, meaning they primarily acted as causal factors influencing other criteria. These included bankruptcy risk, cost of financing, interest rate, tax advantage, and earnings per share. In contrast, criteria such as financial flexibility, cash flows, expected debt ratio, post-financing value, and company control had negative D−R values, meaning they were more affected by other factors in the system. This distinction clarified which criteria serve as key drivers in the financing decision structure and which criteria respond to changes in the system.

To simplify the network of interactions and retain only meaningful relationships, a threshold value was applied to the total-relation matrix. This threshold was calculated as the mean of all elements in the matrix T and was found to be 0.391185. Any relationships with values lower than this threshold were excluded from the network. This filtering helped focus the analysis on only the strongest and most influential links between the criteria, improving the reliability of the network structure used in the subsequent ANP analysis.

Table 2 provides an example of the filtered total-relation matrix, where all values below the threshold have been converted to zero.

**Table 2. Filtered Total-Relation Matrix After Applying Threshold (Values < 0.391 Set to 0)**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| A | — | 0.52 | 0.63 | 0.47 | 0.00 | 0.41 | 0.00 | 0.53 | 0.00 | 0.00 |
| B | 0.48 | — | 0.58 | 0.51 | 0.00 | 0.00 | 0.42 | 0.49 | 0.00 | 0.00 |
| C | 0.61 | 0.54 | — | 0.60 | 0.00 | 0.56 | 0.45 | 0.57 | 0.00 | 0.00 |
| D | 0.00 | 0.43 | 0.51 | — | 0.00 | 0.00 | 0.47 | 0.00 | 0.00 | 0.00 |
| E | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| F | 0.46 | 0.00 | 0.55 | 0.49 | 0.00 | — | 0.00 | 0.44 | 0.00 | 0.00 |
| G | 0.00 | 0.41 | 0.00 | 0.42 | 0.00 | 0.00 | — | 0.00 | 0.00 | 0.00 |
| H | 0.53 | 0.00 | 0.57 | 0.00 | 0.00 | 0.44 | 0.00 | — | 0.00 | 0.00 |
| I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — | 0.00 |
| J | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | — |

After constructing the network structure through the TOPSIS analysis, the Analytic Network Process (ANP) was applied to determine the relative weights of each criterion and financing alternative. Pairwise comparison questionnaires were completed by the 20 financial experts, and their judgments were aggregated using the

geometric mean method to reduce individual bias. The judgments were entered into the ANP model, and the unweighted supermatrix, weighted supermatrix, and limiting supermatrix were generated.

The limiting supermatrix represented the converged final weights after iterative multiplications, indicating the relative importance of each criterion and each financing alternative. Table 3 presents the weights and rankings of all criteria based on the limiting supermatrix.

**Table 3. Ranking of Criteria Based on ANP Limiting Supermatrix**

| Rank | Criterion | Weight |
|---|---|---|
| 1 | Bankruptcy Risk | 0.135145 |
| 2 | Cost of Financing | 0.115566 |
| 3 | Expected Debt Ratio | 0.096988 |
| 4 | Interest Rate | 0.058685 |
| 5 | Cash Flows | 0.038602 |
| 6 | Degree of Company Control | 0.033886 |
| 7 | Post-Financing Value | 0.010184 |
| 8 | Financial Flexibility | 0.006522 |
| 9 | Earnings per Share | 0.002859 |
| 10 | Tax Advantage | 0.001563 |

Based on these results, bankruptcy risk, cost of financing, and expected debt ratio emerged as the three most influential criteria in selecting financing methods. Tax advantage and earnings per share received the lowest weights, indicating limited influence on decision-making.

The same ANP process was used to calculate the weights of the three financing method alternatives. Table 4 presents their normalized, ideal, and raw scores.

**Table 4. Prioritization of Financing Options Based on ANP Analysis**

| Financing Option | Normalized Score | Ideal Score | Raw Score |
|---|---|---|---|
| Inter-Unit Loans | 0.47396 | 1.000 | 0.236978 |
| Capital Increase from Parent Company | 0.31467 | 0.664 | 0.157334 |
| Bank Loans | 0.21138 | 0.446 | 0.105689 |

The analysis revealed that inter-unit loans had the highest priority among the financing options, followed by capital increase from the parent company. Bank loans received the lowest priority according to the experts' judgments.

To validate the performance of the proposed decision-making model, the weighted average cost of capital (WACC) of 13 subsidiaries was compared under two conditions: (1) based on their actual financing structure and (2) based on the optimized structure recommended by the model. Table 5 presents this comparison.

**Table 5. Comparison of WACC in Real vs. Proposed Model Conditions**

| Subsidiary No. | WACC (Real, %) | WACC (Proposed, %) |
|---|---|---|
| 1 | 28 | 26.5 |
| 2 | 26 | 25.5 |
| 3 | 28.2 | 26 |
| 4 | 25.2 | 26 |
| 5 | 29 | 28 |
| 7 | 28.2 | 29 |
| 8 | 29 | 26 |
| 9 | 27 | 25.3 |
| 12 | 27 | 28 |

| | | |
|---|---|---|
| 14 | 28.43 | 27 |
| 15 | 28 | 26.6 |
| 16 | 27.2 | 25.4 |
| 17 | 28 | 27 |

The comparison showed that in 10 out of 13 subsidiaries, the proposed model reduced the WACC. This indicates that implementing the model can significantly lower the overall cost of capital, primarily because inter-unit loans, which carry no explicit cost, were selected as the preferred financing method. By reducing reliance on costly external borrowing, the model improves financial efficiency and resource allocation within the organization.

## 4. Discussion and Conclusion

The findings of this study provide important empirical insights into the prioritization of financing methods across economic sectors in Iran, with a specific focus on the National Iranian Gas Company (NIGC). By integrating the TOPSIS and Analytic Network Process (ANP) techniques, the study identified bankruptcy risk, cost of financing, and expected debt ratio as the three most influential criteria in financing decisions, while inter-unit loans emerged as the most preferred financing method, followed by capital increases from the parent company, and bank loans ranked last. This section discusses these results in light of the existing literature, highlighting their implications and theoretical contributions.

The prioritization of bankruptcy risk as the most critical criterion aligns strongly with global evidence underscoring the centrality of risk considerations in corporate financing decisions. Several studies have emphasized that firms and financial institutions tend to prioritize the stability of their capital structures over potential returns when confronted with volatile or uncertain economic conditions [1, 3]. The finding that bankruptcy risk carried the highest weight suggests that NIGC's decision-makers are highly risk-averse, which is rational given the systemic consequences of financial distress in a state-owned conglomerate operating critical infrastructure. Similar findings have been reported in the context of Islamic banks, where risk-sharing instruments are used cautiously and primarily when institutional safeguards are strong [6]. This emphasis on avoiding insolvency risk reinforces the idea that, in environments with underdeveloped capital markets and macroeconomic volatility, financial sustainability becomes the dominant consideration shaping financing strategies [5].

Closely following bankruptcy risk was the cost of financing, which ranked as the second most important criterion. This aligns with evidence suggesting that financing costs exert a direct and powerful influence on capital structure decisions, especially in economies where interest rates are volatile and the cost of external debt can erode profitability [2, 4]. The sensitivity to financing costs also mirrors trends observed in post-bail-in European banking systems, where the removal of implicit state guarantees led banks to pivot toward low-cost, stable funding sources to preserve margins [2]. For Iranian companies, where access to international capital is limited and domestic borrowing costs are often high due to inflationary pressures, minimizing financing costs is essential for sustaining operational efficiency. The high weight assigned to cost considerations also reflects the broader institutional logic identified in prior studies, which show that firms operating in emerging markets often favor internal or retained earnings over debt financing to avoid interest burdens and currency risks [1, 10].

The expected debt ratio was ranked as the third most influential criterion, highlighting concerns about leverage and capital structure balance. This is consistent with studies indicating that maintaining optimal leverage ratios is essential for preserving credit ratings, reducing the cost of capital, and ensuring access to future financing [3].

Excessive leverage has been associated with heightened vulnerability to credit risk, particularly in the Iranian context where macroeconomic instability amplifies the risk of debt overhang [10]. The finding that leverage is a key consideration complements the emphasis on bankruptcy risk, as both criteria collectively underscore the importance of financial stability. Similar patterns have been reported in Islamic banking research, which has shown that the stability of risk-sharing financing mechanisms depends critically on maintaining balanced leverage structures [6, 7].

By contrast, criteria such as tax advantage, earnings per share, and post-financing firm value received very low weights. This indicates that strategic financing decisions at NIGC are driven less by shareholder-centric performance indicators and more by systemic risk, cost, and structural stability considerations. This finding resonates with observations from state-owned banks and infrastructure conglomerates in other jurisdictions, where managerial priorities often emphasize solvency and operational continuity over market-based performance metrics [1]. It also suggests that the conventional trade-off theory of capital structure, which posits that firms weigh tax shields against bankruptcy costs, may have limited explanatory power in state-dominated financial systems such as that of Iran, where tax incentives are relatively less salient and bankruptcy carries far higher reputational and political costs.

The most striking result of the study is the ranking of inter-unit loans as the highest-priority financing method, followed by capital increases from the parent company, and finally bank loans as the least preferred option. This result carries several theoretical and practical implications. The preference for inter-unit loans demonstrates a strong inclination toward internal capital market mechanisms. Internal loans allow financially stronger subsidiaries to transfer surplus liquidity to capital-constrained units within the same corporate group, thereby reducing dependence on external financing. This mechanism minimizes transaction costs, bypasses credit market frictions, and shields subsidiaries from the high interest rates and credit rationing that often characterize bank lending in Iran. These findings are consistent with international evidence showing that diversified conglomerates often rely on internal capital markets to allocate resources more efficiently under financial constraints, thereby reducing the overall cost of capital and mitigating bankruptcy risk [1, 3].

Moreover, the use of internal loans resonates with the principle of resource mobilization emphasized in studies of Islamic banking. Internal financing mirrors some features of risk-sharing contracts by aligning incentives within the corporate group and reducing agency conflicts. Previous studies in Iran have similarly noted the underutilized potential of mobilizing internal banking resources to meet funding needs and alleviate pressure on the external credit system [9]. This internal redistribution of funds can also be interpreted as a form of financial self-sufficiency strategy, which has become increasingly important in the face of international sanctions and restricted access to foreign capital markets. The high ranking of inter-unit loans therefore signals a rational adaptation to structural constraints in the Iranian financial system.

Capital increases from the parent company ranked second in priority. While this method also represents an internal financing channel, it differs from inter-unit loans by permanently altering the equity structure rather than providing temporary liquidity support. The preference for equity-based injections over bank loans suggests a conservative approach to leverage, consistent with the prioritization of bankruptcy risk and expected debt ratio discussed earlier. Similar findings have been reported in post-crisis European banks, which shifted toward stable equity-like funding structures to reinforce their capital bases and meet stricter regulatory requirements [2, 5]. This result also aligns with the notion that, in high-risk environments, firms prefer equity financing to preserve solvency even at the expense of potential dilution of control or return on equity [3].

Bank loans were ranked as the least preferred financing method. This result reflects deep-seated structural issues in the Iranian banking system, including high borrowing costs, stringent collateral requirements, and the limited capacity of banks to support large-scale long-term financing due to liquidity constraints. The finding is supported by broader literature showing that over-reliance on debt financing can expose firms to liquidity shocks and magnify credit risk, particularly in environments where asset quality is volatile and regulatory oversight is inconsistent [3, 10]. Additionally, in Islamic banking systems, conventional interest-bearing bank loans are often discouraged or structurally constrained, leading firms to prefer equity-like or internal funding sources [6, 7]. The low preference for bank loans thus aligns with the risk-averse orientation observed in NIGC's financing behavior and reflects a strategic shift away from interest-based borrowing in favor of more stable internal sources.

Beyond the immediate context, these findings contribute to a broader understanding of how institutional, technological, and sustainability-related forces are reshaping financing decisions globally. The prioritization of risk and internal funding aligns with research on the transformation of banking systems under digitalization and ESG pressures. The digitalization of banking has improved banks' ability to assess and manage credit risk in real time, encouraging them to be more selective and conservative in their lending practices [12, 14, 15]. This has indirectly increased the relative attractiveness of internal financing for firms, especially those operating in regulated or risk-sensitive sectors. Similarly, the growing integration of ESG frameworks into banking decision-making has led banks to allocate capital preferentially to low-risk and environmentally compliant projects [16-18]. Firms that lack strong ESG credentials or operate in high-risk environments may thus face higher borrowing costs or tighter credit access, further reinforcing the strategic value of internal funding. In this sense, the results of this study echo the literature showing that shifts in regulatory and normative frameworks can indirectly shape corporate financing structures by altering the availability and cost of external capital [4, 13].

Additionally, the findings align with the theoretical proposition that financial institutions and conglomerates in emerging markets must develop hybrid financing architectures that combine internal and external sources to balance risk, cost, and flexibility [1, 2]. The study demonstrates that the ANP-TOPSIS framework can be used effectively to quantify the relative importance of multiple financing criteria and evaluate alternative strategies under conditions of uncertainty and resource constraints. This methodological contribution addresses a gap in prior literature, which has often treated financing decisions as unidimensional choices rather than multi-criteria optimization problems [20]. By incorporating criteria such as bankruptcy risk, cost, leverage, interest rate, and corporate control simultaneously, the model developed in this study offers a more holistic and realistic basis for strategic financing decisions in complex organizational settings.

Despite its contributions, this study has several limitations that should be acknowledged. First, the sample was limited to 20 financial experts from within NIGC and its subsidiaries, which may restrict the generalizability of the findings. Although these experts possessed substantial experience, their perspectives may reflect organizational norms specific to NIGC rather than the broader Iranian corporate sector. Second, the model was constructed using data from a single industry—energy infrastructure—which is highly capital-intensive and risk-sensitive. The weighting of criteria and preference for internal loans may differ in other sectors such as services or technology, where financing dynamics are shaped by different risk-return profiles. Third, while the ANP-TOPSIS framework is powerful in capturing multi-criteria trade-offs, it relies on subjective expert judgments, which may introduce bias despite the use of aggregation methods and consistency checks. Finally, the study focused exclusively on financial criteria and did not incorporate qualitative factors such as regulatory uncertainty, political risk, or organizational culture, which could also influence financing preferences.

Future studies should aim to expand the sample to include a more diverse set of companies across multiple industries to enhance external validity and enable comparative analysis. Incorporating firms from sectors such as manufacturing, services, and technology would allow researchers to assess whether the prioritization of bankruptcy risk and internal funding is a generalizable phenomenon or specific to capital-intensive industries. Future research could also integrate additional criteria into the decision model, such as ESG performance metrics, digital transformation maturity, and innovation capacity, which are increasingly influencing financing decisions. Moreover, longitudinal studies tracking changes in financing preferences over time would help to capture dynamic shifts driven by regulatory reforms, macroeconomic cycles, or technological disruptions. Finally, future research could combine quantitative multi-criteria methods with qualitative approaches, such as in-depth interviews or case studies, to gain richer insights into the organizational and institutional drivers of financing choices.

Practitioners and financial managers in conglomerate structures should consider developing formal internal capital market mechanisms, such as structured inter-unit lending frameworks, to optimize the allocation of liquidity across subsidiaries and reduce reliance on costly bank debt. Establishing centralized treasury units could facilitate the monitoring and redistribution of funds based on real-time cash flow forecasts and risk assessments. Organizations should also strengthen their internal risk management systems to continuously monitor leverage, bankruptcy risk, and financing costs, thereby ensuring that financing strategies remain aligned with evolving market conditions. Finally, policymakers and regulators could support corporate financing efficiency by promoting hybrid financing models that blend internal and external sources, offering incentives for firms to build internal liquidity reserves while gradually deepening capital market infrastructure to reduce systemic dependence on banks.

## Authors' Contributions

Authors equally contributed to this article.

## Ethical Considerations

All procedures performed in this study were under the ethical standards.

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## Conflict of Interest

The authors report no conflict of interest.

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