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Aim and Scope:

The Journal of Emerging Technologies in Accounting (JETA) has started with the aim of expanding the concepts of accounting, auditing and finance in English in order to identify and eliminate gaps in these areas.

The Journal of Emerging Technologies in Accounting (JETA) accepts the articles in the form of Research Article, Review Article, Short Papers, Case-study, Methodologies including these items:

- Emerging technology in the field of Accounting and its future
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- Corporate Governance and the related subjects
- Internal and external auditing and there innovation
- Risk management and its new technologies
- Internal control and new technologies
- Integrated and modern accounting information systems in the organization
- Other research topics related to emerging technologies in accounting

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Influence of Tax Avoidance on Bank Loan Contracts with Emphasis on the Moderating Role of Disclosure Quality

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Abstract

Objectives: This research aims to investigate the influence of tax avoidance on bank loan contracts, with a focus on the moderating role of disclosure quality. Emphasizing the quality of disclosure as a means to mitigate information asymmetry and agency costs can help alleviate the negative consequences of tax avoidance on bank loan contracts.

Methodology/Design/Approach: The multivariate linear regression method was utilized to test the research hypotheses and Eviews 9 software was utilized for the final analysis of the data. The statistical population for this research consists of firms listed on the Tehran Stock Exchange. Due to certain restrictions, a total of 125 firms were selected for examination from the years 2013 to 2019.

Findings: Tax avoidance positively impacts bank loan contracts. The influence of disclosure quality on this relationship varies depending on the criteria used to measure tax avoidance. When the effective rate of cash tax paid is considered, tax avoidance reduces the three criteria of bank loan structure, cost, and collateral. However, when using the book-tax difference criterion, tax avoidance reduces the structure, expense, and risk of non-payment of bank loans.

Innovation: This research, conducted for the first time in Iran's economic landscape, aims to enhance theoretical foundations and research literature on tax avoidance and bank loan contracts. The study first examines the theoretical framework and background, then explores the relationship between tax avoidance, bank loan contracts, and disclosure quality.

Keywords: Tax avoidance, Bank loan contracts, Disclosure quality.

1. Introduction

Today, companies have various methods aside from capital financing to address their financial needs, such as debt settlement, increasing working capital, and paying dividends to shareholders. Therefore, when making decisions about short-term and long-term financing, managers should carefully assess the impacts and outcomes of each approach, consider them, and gain a comprehensive understanding of financial instruments to utilize appropriate methods in financial markets and select the most optimal financing method. In major industrialized countries, common financing methods include issuing bonds, retaining profits, issuing shares, and obtaining bank loans (Malanazari et al., 2009). Conversely, in Iran, bank loans play a significant role in financing companies (Heidari and Hemti, 2014; Ahmadpour et al., 2015). Banks serve as primary suppliers to companies, and bank loan agreements serve as crucial methods of foreign financing for companies, even large state-owned ones (Brat and Sander, 2008).

Typically, company managers prefer financing through debt (borrowing) due to tax savings and lower rates compared to shareholders' expected returns. However, for lenders, the primary concern when granting loans and credits is the borrower's ability to repay the principal and interest. In Western countries like the United States, lenders rely on companies' financial statements to evaluate their repayment capacity, with the profit and loss statement, especially profit before interest, being of particular importance. Recognizing the significance of financial statements, particularly the profit and loss statement, in loan approval decisions, company managers can showcase the company's profitability to attract favorable opinions from creditors, secure necessary capital, and reduce debt costs. This financing method maintains shareholders' control over the company and proves cost-effective during inflationary periods (Kim et al., 2010).

Research background indicates that lenders factor in corporate tax avoidance when assessing loan repayment risks. Tax avoidance involves legally leveraging the tax system to gain personal benefits and reduce tax liabilities within legal boundaries (Pasternak and Rico, 2008). The impact of tax avoidance on bank loan agreements hinges on creditors balancing costs and benefits. Positive effects of tax avoidance on creditors include reducing debt default risks by lowering tax expenses and replacing potential debt financing, thus enhancing a company's credit quality. Conversely, negative effects of tax avoidance may result in increased company risks, tax authority penalties, transparency issues, and conflicts among management, shareholders, and creditors, leading to higher agency costs, damaging creditors' interests, lowering credit quality, increasing debt costs, and imposing restrictions on debt agreements (Blady et al., 2018).

Furthermore, research background reveals that an essential criterion for measuring tax avoidance is the effective cash tax rate, a crucial element in tax discussions. While numerous studies focus on tax avoidance, many rely on short-term effective tax rates, leading to significant deviations due to annual data limitations and potential negative rates from losses. To address these issues, utilizing long-term measures of tax avoidance can determine if companies can sustain tax avoidance practices over time. Long-term rates, as argued by Kim et al. (2010) and Hanlon and Heitzman (2010), offer insights into companies' sustained tax planning activities and overall tax avoidance practices.

Tax avoidance methods are strategies that increase a company's complexity and decrease the quality of its disclosure. Nichols and Stauben (2008) identified disclosure quality as a mechanism to reduce information asymmetry and agency costs resulting from the complexity of tax avoidance programs, alleviating owners' concerns about hidden costs. Therefore, higher disclosure quality correlates with lower tax avoidance, minimizing agency issues (Hikarit and Mohammadi, 1392). If tax avoidance methods diminish financial information quality, creditors may enhance monitoring by extending contract terms. Borrowers typically avoid higher-cost loans with stricter obligations and guarantees,

prompting this study to investigate such cases among firms listed on the Tehran Stock Exchange.

This research, conducted for the first time in Iran's economic landscape, aims to enhance theoretical foundations and research literature on tax avoidance and bank loan contracts. The study first examines the theoretical framework and background, then explores the relationship between tax avoidance, bank loan contracts, and disclosure quality.

Theoretical foundations of research

Avoiding tax and bank loan agreements

A bank loan contract is an agreement between a lender and a borrower on a specific date, where both parties commit to fulfilling each other's obligations according to the terms of the contract. Loan contracts are complex agreements between banks and their customers, typically involving various conditions, including price and non-price conditions (Strahan, 1999). In many countries, loans are offered in packages with conditions tailored to the borrower's needs (Melnik and Plot, 1986). The cost of debt, loan amount, maturity period, and collateral requirements are non-price conditions included in loan contracts. Banks may also impose restrictions on borrowers to ensure repayment, such as limitations on dividends, asset sales, mergers, investments, and production. Financial ratios like debt ratio and working capital ratio may also be used as restrictions. These non-price conditions can result in indirect costs for borrowers, such as missing profitable investment opportunities. Short-term loans may be offered by banks to assess repayment capability and maintain bargaining power. Non-price conditions are often linked to pricing terms, with higher interest rates typically associated with lower loan amounts, more collateral, and shorter maturity periods.

Previous studies (Graham et al., 2008; Ji, 2012) have considered loan characteristics like loan amount, lender type, maturity period, and guarantee as control variables when analyzing loan contract provisions. Both price and non-price conditions in loan contracts are used by banks as risk-compensating mechanisms for borrowers. Company-specific characteristics, such as tax avoidance, can also influence loan contract provisions. Tax avoidance involves legally reducing taxes to benefit shareholders and increase company value. Tax avoidance can lead to managerial opportunistic behaviors, increasing agency costs like profit manipulation and related party transactions. This behavior poses risks to companies and creditors, leading to higher agency costs and credit risk in companies with tax avoidance. High tax risk companies may face greater damage from tax avoidance, impacting loan agreements significantly.

Tax avoidance, bank loan contracts, and disclosure quality

Since shareholders and creditors are the two main groups of users of financial information, providing timely and reliable information for these two groups is one of the main concerns of management and accounting information systems, with a focus on transparency. The information prepared for these two groups has a special importance (Qurbani et al., 2012). Achieving long-term economic goals depends on the proper functioning of financial markets, especially the capital market, which relies on the availability of highly transparent information. Transparent information not only reduces information asymmetry between company management and external investors but also between traders. Therefore, the quality of disclosure can decrease information inefficiency, leading to improved market conditions and increased liquidity of companies' shares. The provision of better and more information allows real and legal investors to conduct more thorough analyses, ultimately moving the capital market towards higher efficiency (Foroghi and Farjami, 2014). Financial statements are the cornerstone of the financial reporting process, including the balance sheet, profit and loss statement, comprehensive profit and loss statement, cash flow statement, and explanatory notes (Munajati et al., 2013). Financial reporting serves as the primary means of conveying information to investors, aiming to create a clear image and accurate expectations of the

company (Ming et al., 2011). However, following recent financial scandals like Enron, Worldcom, and Parmalat, investors' trust in financial reporting systems has waned, emphasizing the importance of disclosure quality in determining the credibility and reliability of reported figures. Consequently, the transparency of accounting information and its impact on financial reporting systems have become of interest to investors, managers, legislators, and standards compilers (Qurbani et al., 2013).

Singavi and Desai (1971) define quality as completeness, correctness, accuracy, and reliability. If companies disclose information that is reliable and timely, the quality of information disclosure is considered higher (Stock Exchange Organization, 2015). Constructs such as appropriateness, comprehensiveness, and timeliness have been used to represent disclosure quality (Wallace et al., 1994). King (1996) suggests that in the absence of anti-fraud regulations, the quality of disclosure can be defined by the degree of bias based on managers' interests. Hopkins (1996) describes the ease of studying and interpreting financial statements by investors as the quality of disclosure.

According to Hosseini and Mosli (2010), the quality of disclosure depends on the amount of information disclosed and the richness of additional information. Ponnall and Schipper (1999) consider financial statements to be of quality if they exhibit transparency, full disclosure, and comparability. The terms "quality" of disclosure of accounting information and "transparency" of a disclosure system are often used interchangeably, and defining precise consensus on "transparency" and "quality" remains challenging. Various constructs have been used to represent the quality of disclosure, such as appropriateness, comprehensiveness, awareness, and sometimes as a representative of disclosure quality (Mahdavi et al., 2014).

Transparency is defined as openness in dictionaries and platforms, indicating honesty, easy understanding, clarity of information, and ease of access to operations within institutions (Khajavi et al., 2014). Tax avoidance significantly impacts corporate debt financing, leading to higher bank borrowing costs and reduced loan terms. Companies must consider tax costs against capital costs when making tax decisions. Good corporate governance and improved information quality can mitigate the negative effects of tax avoidance on debt contracts, potentially reducing agency problems and tax avoidance costs by enhancing management and disclosure quality. Increasing disclosure quality reduces information asymmetry and the adverse effects of agency problems on a company's value. Quality corporate disclosure assists banks in identifying the motives behind corporate tax avoidance and evaluating its economic effects accurately. Enhanced corporate disclosures are often seen as indicators of improving information asymmetry, helping banks understand firms' operating conditions and reducing the negative impact of tax avoidance on quality debt financing (Blady et al., 2018).

Tax avoidance methods can increase a company's complexity and reduce the quality of its disclosure. Quality disclosure serves as a mechanism to reduce information asymmetry and agency costs resulting from tax avoidance programs, alleviating owners' concerns about hidden tax avoidance costs (Nichols and Stauben, 2008). Higher disclosure quality leads to lower tax avoidance and fewer agency issues (Hikarit and Mohammadi, 2012). For firms with lower disclosure quality, tax avoidance can significantly increase complexity, resulting in higher agency costs and additional direct costs. Banks are less worried about the negative impacts of tax avoidance on companies with high disclosure quality, potentially leading to lower bank loan restrictions for these companies compared to those with lower disclosure quality engaging in tax avoidance (Blady et al., 2018).

Research background

Bladi et al. (2018) conducted research on the impact of tax avoidance on bank loan contracts. Utilizing data from Chinese listed companies, they discovered a positive correlation between tax avoidance and bank

loans and loan costs, while finding a negative correlation with loan terms. The study revealed that Chinese banks have heightened financial costs for companies engaging in tax avoidance. Additionally, tax avoidance behavior was linked to increased default probability and collateral requirements for bank loans. The study also noted that the influence of tax avoidance on bank loan contracts diminishes with improved corporate disclosure quality, highlighting the significance of potential agency costs in tax avoidance on bank loan agreements. These findings further elucidate the economic repercussions of corporate tax avoidance and credit-risk transactions by commercial banks.

Diaz Duarte et al.'s (2017) research indicated that bank loan collateral serves as a tool for banks to evaluate borrower credit quality and mitigate poor decision-making risks. By preventing asset replacement issues, bank guarantees lower debt agency costs. Furthermore, loan collateral mitigates moral hazard concerns by discouraging risk transfer behaviors. In less developed countries, information asymmetry and weak credit information systems make it challenging to assess bank risks, leading to increased collateral requests for loan approval.

Hassan and Song (2014) explored the impact of profit predictability on bank debt contracts. Analyzing 8022 bank loan contracts from American companies, they found that firms with higher profit predictability enjoy more favorable loan terms, such as lower interest rates and longer maturity periods, with less stringent conditions and collateral requirements. The study highlighted the relationship between profit predictability and bank loan costs, influenced by private information access, competition between banks and bond investors, and company size.

Kim et al. (2010) delved into the effects of tax avoidance on bank loans, revealing that companies engaging in tax avoidance face fewer contractual restrictions from banks, particularly those with higher credit risks. Firms adept at tax avoidance are less likely to breach contract terms, indicating that banks view tax avoidance as a positive factor in enhancing credit quality, leading to more favorable loan terms. Ebrahimi et al. (2016) investigated the impact of government ownership and political connections on disclosure quality and tax avoidance, finding that both factors negatively affect disclosure quality, with government ownership showing no significant impact on corporate tax avoidance.

Dilmi et al. (2014) studied the relationship between disclosure quality and bank financing facilitation, concluding that improved disclosure quality enhances companies' ability to secure bank loans. Enhanced disclosure quality is crucial in negotiating favorable debt contract terms and accessing bank loans. Satish et al. (2012) explored the link between disclosure quality and financing limitations, revealing a negative correlation between accrual quality and financing restrictions, while no significant relationship was found between overall disclosure quality and financing limitations.

Based on the theoretical foundations presented, the following research hypotheses have been formulated:

First hypothesis: There exists a correlation between corporate tax avoidance and bank loan contracts.

Second hypothesis: Disclosure quality moderates the association between tax avoidance and bank loan contracts.

Research method

The multivariate linear regression method was utilized to test the research hypotheses and Eviews 9 software was utilized for the final analysis of the data. The statistical population of the current research consists of firms listed on the Tehran Stock Exchange, meeting specific criteria: firms listed on the Tehran Stock Exchange before the fiscal year 2015; firms in the intermediation, investment, leasing, and insurance industries with no changes in activity or financial year from 2006 to 2020; firms with a total profit before tax that is not negative and have received facilities during the research period with relevant data available. To ensure uniformity among the considered firms, only those with fiscal years ending on March 29 were

examined. Following these restrictions, 125 firms were selected for review from 2013 to 2019.

The research variables include four types: dependent, independent, moderator, and control variables. The dependent variable of the research is bank loan contracts, measured by four criteria according to Blady et al. (2018):

1) Loan structure: Ratio of total loan facilities obtained to total debts.
2) Loan cost: Ratio of loan interest cost to total loan amount.
3) Bank loan collateral (security): A virtual variable where checks and promissory notes are given a value of one (1), while other collaterals are considered zero (0) (Hajiha and Taghizadeh, 2017).
4) Loan default risk: Difference between the company's short-term loans from the past year and loans repaid in the current period. If the difference is greater than zero, indicating inability to repay debt, it is assigned a value of one (1); otherwise, zero (0).

The independent variable of the research is tax avoidance, with two criteria based on previous research (Boladi et al., 2018; Hassan and Sang, 2014; Manzon and Plasko, 2001):

1. The effective tax rate is the amount of cash paid in taxes, calculated by dividing the total cash taxes paid over a five-year period by the total profit before tax for the same period. A decrease in the effective cash tax rate indicates a higher level of tax avoidance.Which is as follows:

$$cashetr_{it} = \frac{\sum_{t-4}^{t} cashtaxespaid_{it}}{\sum_{t-4}^{t} pretaxincom_{it}} \qquad (1)$$

2. The key factor in determining tax differences is the method used, as measured by the model (Desi-Dharmapala).

Tax income discrepancies are influenced by a company's control over discretionary accruals, calculated by dividing total discretionary accruals by total assets.

In this approach, tax-accounting variances are analyzed against all accruals, with the remaining difference attributed to tax avoidance.

The DD regression model is outlined as follows:

$$Bt - diff_{it} = \beta_0 + \beta_1 \frac{ta_{it}}{at_{it}} + y_i + \varepsilon_{it} \qquad (2)$$

Which, in this model:

ta_{it}: The total accruals of Company i at the end of year t are calculated as the difference between profit (loss) after tax deduction and cash flows resulting from operational activities in the cash flow statement for the current period.

at_{it}: Total assets of the company at the end of the period.

ε_{it} : The residual terms in equation (2) measure the tax book difference as the level of tax avoidance of the company.

The moderator variable in this research is Disclosure Quality (DQ), which measures the disclosure rating of companies calculated by the Tehran Stock Exchange Organization since 2012 over 3, 6, and 9-month periods. This rating reflects the organization's assessment of the information content in companies' disclosures, calculated based on the average weight of criteria such as timeliness and reliability of disclosed information. The ranking is primarily determined by the information disclosure regulations for stock exchange companies approved by the Supreme Council of the Stock Exchange. It evaluates companies based on published annual information, quarterly information, management forecasts, and other published information, using criteria of timeliness and reliability. To calculate the total rank of corporate disclosure, weights of two-thirds for timeliness and one-third for reliability are used. In this research, the points awarded to companies are used to measure the quality of disclosure, with a maximum quality score of 100 (Mojtahedzadeh et al., 2014).

The control variables in this research, based on theoretical foundations and background, include:

- Cash held, calculated as the ratio of total cash and short-term investments to total assets.
- Company size (Size), represented by the natural logarithm of stock market value.
- Return on Assets (ROA), the ratio of profit before tax deduction to total assets.
- Financial Leverage (LEV), the ratio of book value of total debt to total assets.
- Net ratio of property, machinery, and equipment to total assets (PPE).
- Annual sales growth rate (Growth), the ratio of the difference between current year's sales and previous year's sales to previous year's sales.
- Market value of equity to book value (M/B).

Research findings

The descriptive statistics of the research variables are presented in Table 1. The structure of the loan and the cost of the bank loan, with averages of 0.361 and 0.173 respectively, indicate that 36% of bank loan facilities are present in most of the sample companies compared to total debts, and that bank loans have low costs in most of the sample companies. Additionally, 704 (about 81 percent) of the sample companies have used checks and promissory notes as guarantees to receive facilities, while 249 (about 29 percent) of the companies are unable to repay the loan. The average values obtained for the variables effective cash tax rate and tax book difference show that most data related to these variables are centered around the numbers 0.146 and 0.043, respectively. The average effective rate of cash tax paid indicates a high level of tax avoidance in most of the sample companies. In terms of the modifier variable of disclosure quality, the year-to-year disclosure rating of the sample companies in terms of timeliness and reliability recognized by the Stock Exchange Organization is around 220.76, indicating a high level of disclosure by most of the sample companies. Finally, it should be noted that the closeness of the mean and median in all variables of the model indicates the normality and symmetry of the data of these variables, and the dispersion parameters are a measure to determine the degree of dispersion of the data with each other or the degree of their dispersion compared to the average. One of the most important dispersion parameters is the standard deviation. The value of this parameter for cash holding and equity ratio is 0.072 and 2.00, respectively, showing that they have the highest and lowest dispersion among the research variables, respectively.

Table No. 1. Descriptive statistics of research variables

standard deviation	minimal	the maximum	the middle	average	Average number of observations	Variables
0.217	0.000	0.871	0.361	0.361	875	Bank loan structure
0.114	0.000	0.757	0.169	0.163	873	Bank loan cost
0.396	0.000	1	1	0.805	874	Bank loan collateral
0.451	0.000	1	0.000	0.285	875	Risk of non-payment of bank loans
0.096	0.000	0.965	0.139	0.146	874	The effective cash tax rate
0.083	-0.349	0.473	-0.016	-0.43	873	Book tax difference
16.866	14.32	99.91	80.895	76.22	868	Disclosure quality
0.072	0.0003	0.479	0.037	0.062	875	Keeping cash
0.179	0.108	1.269	0.589	0.578	875	Financial leverage
2.005	-23.405	18.255	2.168	2.575	874	value ratio Owners of shares at book value
0.177	0.013	0.850	0.224	0.260	875	Net property, plant, and equipment to total assets
0.137	-0.404	0.675	0.125	0.147	875	Rate of return on assets
1.520	10.660	19.190	13.768	13.988	875	size

In order to determine the appropriate model and estimate the research model where the dependent variable is not zero or one, i.e., ordinary least squares, Limer and Hausman's F test was utilized. This test was estimated in all OLS models with fixed effects. Based on the chi-square statistic and the significance level of the Hausman test, the fitting of the research model for testing all ordinary least squares models in panel data form was conducted using the fixed effects model.

To assess the goodness of fit in generalized least squares models, the Hosmer-Lemeshow test was employed. In all models, the statistic was above 5%, indicating a good model fit. The Levin, Lin, and Chu (2002) unit root test was used to determine the significance of the research variables, and all variables were found to be significant, avoiding the issue of false regression. Prior to Limer and Hausman's F test, a collinearity test was conducted. Collinearity occurs when an independent variable is a linear function of other independent variables. However, in all tests, the variance inflation factor for all variables was less than 10, indicating no collinearity issues among the independent variables in the research.

In both ordinary and generalized least squares models, the adjusted coefficient of determination and McFadden's R^2 were used to show the percentage changes of the dependent variable due to the independent variable, as well as the significance level of the model in ordinary and generalized least squares, respectively, compared to the F significance level. The probability statistic calculated for all models was less than 5%.

To test the first hypothesis, the following regression model was utilized:

$$blc_{it} = \beta_0 + \beta_1 tax\_avoidance_{it} + \beta_2 cash_{it} + \beta_3 size_{it} + \beta_4 roa_{it} + \beta_5 lev_{it} + \beta_6 ppe_{it} + \beta_7 growth_{it} + \beta_8 mtb_{it} + \varepsilon_{it} \quad (3)$$

The results of the test on the first hypothesis of the research, using bank loan structure as the criteria for measuring bank loan contracts in Table 2, show that at a 95% confidence level, there is a significant negative (positive) relationship between the effective cash tax rate (book-tax difference) and the bank loan structure. Therefore, the first hypothesis was confirmed by measuring the effective tax rate and accounting difference as the independent variable, and bank loan structure as the dependent variable.

Table number 2. Results of the first hypothesis test

Bank loan structure						independent variable
significance level	**t-statistic**	**regression coefficient**	**significance level**	**t-statistic**	**regression coefficient**	**variable**
----	----	----	0.027	2.219	-0.099	The effective cash tax rate
0.000	6.271	0.223	----	----	----	Book tax difference
0.047	-1.987	-0.078	0.713	0.369	0.025	Keeping cash
0.000	4.015	026/0	0.204	-1.270	-0.012	Sales growth rate
0.000	6.132	165/0	0.971	0.036	002/0	Financial leverage
0.000	5.381	0.007	0.010	2.598	004/0	Ratio of market value to book equity
0.000	7.125	0.262	0.023	2.274	0.239	Property, machinery, and equipment
0.076	1.777	0.049	0.009	2.642	0.072	Rate of return on assets
0.000	-12.75	-0.038	0.500	-0.675	-0.008	Company size
0.000	17.89	0.705	0.007	2.729	0.388	Fixed coefficient
----	----	----	0.000	5.083	0.475	Virtual variable
56.372			24.593			F statistic
0.000			0.000			The significance level of F
0.894			0.808			Adjusted coefficient of determination
1.846			2.158			Durbin-Watson statistic

The results of the first hypothesis test in the research, using the bank loan cost criterion to measure bank loan contracts in Table 3, indicate that at a 95% confidence level, there is a significant negative (positive) relationship between the effective cash tax rate (book-tax difference) and the bank loan cost. Therefore, the first hypothesis, which measured the effective tax rate and accounting difference as the independent variable and bank loan cost as the dependent variable, was confirmed.

Table number 3. Results of the first hypothesis test

Bank loan structure						independent variable
significance level	**t-statistic**	**regression coefficient**	**significance level**	**t-statistic**	**regression coefficient**	**variable**
----	----	----	0.000	-4.311	-0.085	The effective cash tax rate
0.000	7.581	0.253	----	----	----	Book tax difference
0.004	-2.861	-0.108	0.011	-2.558	-0.079	Keeping cash
0.267	1.111	0.006	0.908	0.115	0.001	Sales growth rate
0.978	0.028	0.001	0.128	-1.524	-0.024	Financial leverage
0.000	-5.199	005/0-	0.000	-4.360	-0.006	Ratio of market value to book equity
0.000	-6.165	-0.130	0.000	-7.730	-0.146	Property, machinery, and equipment
0.000	-6.579	-0.189	0.000	-6.925	-0.109	Rate of return on assets
0.000	8.994	0.023	0.000	4.198	0.022	Company size
0.081	-1.750	-0.071	0.477	-0.712	-0.055	Fixed coefficient
10.293			10.224			Virtual variable
0.000			0.000			F statistic
0.585			0.583			The significance level of F
1.951			1.991			Adjusted coefficient of determination

The results of the first hypothesis test in the research, using the bank loan collateral criterion to measure bank loan contracts in Table 4, indicate that at a 95% confidence level, there is a significant negative (positive) relationship between the effective cash tax rate (book-tax difference) and the bank loan collateral. Therefore, the first hypothesis, which measured the effective tax rate and accounting difference as the independent variable and bank loan collateral as the dependent variable, was confirmed.

Table number 4. Results of the first hypothesis test

Bank loan structure						independent variable
significance level	**t-statistic**	**regression coefficient**	**significance level**	**t-statistic**	**regression coefficient**	**variable**
----	----	----	0.005	-2.814	-2.567	The effective cash tax rate
0.005	2.842	3.284	----	----	----	Book tax difference
0.010	-2.585	-3.065	0.002	-3.080	-3.638	Keeping cash
0.944	0.070	0.020	0.829	0.216	0.060	Sales growth rate
0.370	0.896	0.572	0.138	1.485	0.957	Financial leverage
0.447	-0.761	-0.037	0.414	-0.817	-0.039	Ratio of market value to book equity
0.002	-3.065	-1.563	0.000	-3.792	-1.915	Property, machinery, and equipment
0.105	-1.621	-1.520	0.002	-3.091	-2.605	Rate of return on assets
0.001	3.243	0.205	0.004	2.881	0.182	Company size
0.373	-0.891	-0.845	0.933	084/0-	-0.080	Fixed coefficient

Bank loan structure						independent variable
significance level	t-statistic	regression coefficient	significance level	t-statistic	regression coefficient	variable
0.068			0.068			R^2 McFadden
60.947			60.860			The probability ratio statistic
0.000			0.000			A significance level of the model
(0.390) 8.462			(0.636) 6.098			Hosmer-Lemshow statistic
(0.165) 14.189			(0.366) 10.886			Andrews statistics

The results of the test on the first hypothesis of the research, using the bank loan non-payment risk criterion to measure bank loan contracts in Table 5, show that at a 95% confidence level, there is a significant negative (positive) relationship between the effective cash tax rate (book-tax difference) and the risk of non-payment of bank loans. Therefore, the first hypothesis was confirmed by measuring the effective tax rate and book difference as the independent variable and the non-payment risk as the dependent variable.

Table number 5. Results of the first hypothesis test

Risk of non-payment of bank loans						independent variable
significance level	t-statistic	regression coefficient	significance level	t-statistic	regression coefficient	variable
----	----	----	0.042	-2.034	-1.912	The effective cash tax rate
0.000	4.604	5.369	----	----	----	Book tax difference
0.217	-1.236	-1.575	0.582	-0.550	-0.674	Keeping cash
0.064	1.852	0.460	0.126	1.530	0.375	Sales growth rate
0.044	2.016	0.124	0.019	2.345	1.351	Financial leverage
0.794	0.261	0.010	0.966	-0.043	-0.002	Ratio of market value to book equity
0.000	5.003	2.233	0.000	5.702	2.517	Property, machinery, and equipment
0.150	-1.441	-1.332	0.582	0.551	0.443	Rate of return on assets
0.043	-2.024	-0.111	0.063	-1.875	-0.101	Company size
0.608	-0.513	-0.428	0.365	-0.906	-0.752	Fixed coefficient
0.062			0.046			R^2 McFadden
66.200			48.788			The probability ratio statistic
0.000			0.000			A significance level of the model
(0.151) 12.009			(0.104) 13.249			Hosmer-Lemshow statistic
(0.096) 16.120			(0.142) 14.727			Andrews statistics

The following regression model is also used to test the second hypothesis:

$$blc_{it} = \beta_0 + \beta_1 tax_{avoidance_{it}} + \beta_2 dq_{it} + \beta_3 tax_{avoidance_{it}} * dq + \beta_4 cash_{it} + \beta_5 size_{it} + \beta_6 roa_{it} + \beta_7 lev_{it} + \beta_8 ppe_{it} + \beta_9 growth_{it} + \beta_{10} mtb_{it} + \varepsilon_{it}$$

The results of the second hypothesis test in the research, using the bank loan cost criterion to measure bank loan contracts in Table 7, show that the modifier variable of disclosure quality was applied. This independent variable, effective rate of cash tax disclosure quality (book difference of tax disclosure quality), was used to test the research hypothesis. The regression coefficient value of the displayed variable indicates that at a 95% confidence level, the combined impact of tax avoidance (effective rate of cash tax and book-tax difference) and disclosure quality on bank loan costs is significant. Therefore, the quality of disclosure has an adjusting effect on the relationship between the effective cash tax rate (book-tax difference) and bank loan costs, either increasing or decreasing.

Table number 6. Results of the second hypothesis test

Bank loan structure						independent variable
significance level	**t-statistic**	**regression coefficient**	**significance level**	**t-statistic**	**regression coefficient**	**variable**
----	----	----	0.008	-2.674	-0.231	The effective cash tax rate
0.059	1.895	0.136	----	----	----	Book tax difference
0.043	-2.024	0.000	0.056	1.915	0.000	Disclosure quality
----	----	----	0.012	-2.536	-0.004	Effective cash tax rate Disclosure quality
0.006	-2.753	-0.002	----	----	----	Tax Book Difference Disclosure Quality
0.058	1.902	0.102	0.179	1.346	0.072	Keeping cash
0.956	0.055	0.000	0.056	-1.914	-0.008	Sales growth rate
0.091	-1.695	-0.016	0.484	-0.700	-0.013	Financial leverage
0.000	4.545	0.005	0.000	4.232	0.005	Ratio of market value to book equity
0.015	2.451	0.189	0.004	2.857	0.167	Property, machinery, and equipment
0.404	0.835	0.035	0.007	2.686	0.077	Rate of return on assets
0.005	-2.836	-0.019	0.001	-3.268	-0.020	Company size
0.000	7.303	0.562	0.000	6.618	0.528	Fixed coefficient
0.000	8.439	0.486	0.000	7.788	0.462	Virtual variable
68.263			70.159			F statistic
0.000			0.000			The significance level of F
0.928			0.927			Adjusted coefficient of determination
2.079			2.097			Durbin-Watson statistic

The results of the second hypothesis test in the research, using the bank loan cost criterion to measure bank loan contracts in Table 7, demonstrate that when the modifier variable of disclosure quality is applied to the independent variable effective rate of cash tax disclosure quality (book difference of tax disclosure quality), a research hypothesis is formulated. The regression coefficient value of the displayed variable indicates that, at a 95% confidence level, the combined impact of tax avoidance (the effective rate of cash tax and book-tax difference) and disclosure quality on the cost of bank loans is significant. Therefore, disclosure quality has an adjusting effect on the relationship between the effective cash tax rate (book-tax difference) and bank loan cost, either increasing or decreasing it.

The results of the second hypothesis test in the research, using the bank loan collateral criterion to measure bank loan contracts in Table (8), indicate that when the modifier variable of disclosure quality is applied to the independent variable of effective rate of cash tax (book-tax difference disclosure quality), a research hypothesis is formed. The regression coefficient value of the displayed variable shows that

only the interaction effect of the effective rate of cash tax and the quality of disclosure on bank loan collateral is significant at a 95% level. Therefore, disclosure quality has a moderating effect on the relationship between the effective cash tax rate and bank loan collateral, which increases.

Table number 7. Results of the second hypothesis test

Bank loan cost						independent variable
significance level	t-statistic	regression coefficient	significance level	t-statistic	regression coefficient	variable
----	----	----	0.003	-9.962	-0.231	The effective cash tax rate
0.490	0.691	0.054	----	----	----	Book tax difference
0.000	-4.273	0.000	0.591	-0.538	0.000	Disclosure quality
----	----	----	0.041	-2.049	-0.002	Effective cash tax rate Disclosure quality
0.010	-2.577	-0.003	----	----	----	Tax Book Difference Disclosure Quality
0.000	-4.948	-0.117	0.019	-2.537	-0.087	Keeping cash
0.821	-0.226	-0.002	0.476	-0.714	-0.004	Sales growth rate
0.841	-0.201	-0.003	0.355	-0.925	-0.022	Financial leverage
0.000	-5.765	-0.005	0.000	-4.544	-0.006	Ratio of market value to book equity
0.000	-8.399	-0.111	0.000	-5.874	-0.128	Property, machinery, and equipment
0.000	-10.335	-0.162	0.001	-3.434	-0.092	Rate of return on assets
0.000	5.870	0.025	0.000	8.251	0.023	Company size
0.261	-1.124	-0.070	0.165	-1.390	-0.061	Fixed coefficient
10.194			9.428			F statistic
0.000			0.000			The significance level of F
0.593			0.567			Adjusted coefficient of determination
1.988			2.035			Durbin-Watson statistic

Table number 8. Results of the second hypothesis test

bank loan collateral						independent variable
significance level	t-statistic	regression coefficient	significance level	t-statistic	regression coefficient	variable
----	----	----	0.013	-2.485	-5.467	The effective cash tax rate
0.136	1.493	2.261	----	----	----	Book tax difference
0.483	0.701	0.004	0.215	1.239	0.008	Disclosure quality
----	----	----	0.014	-2.464	-0.063	Effective cash tax rate Disclosure quality
0.097	-1.291	-0.027	----	----	----	Tax Book Difference Disclosure Quality
0.099	-1.651	-2.197	0.039	062/2-	-2.700	Keeping cash
0.907	-0.118	-0.037	0.508	0.661	0.216	Sales growth rate
0.219	1.229	0.910	0.094	1.673	1.266	Financial leverage
0.060	-1.885	-0.108	0.048	-1.979	-0.113	Ratio of market value to book equity
0.004	-2.874	-1.651	0.000	-3.517	-2.008	Property, machinery, and equipment
0.105	-1.622	-1.710	0.018	-2.358	-2.285	Rate of return on assets
0.001	3.261	0.235	0.003	3.012	0.214	Company size
500/0	-0.674	-0.789	0.167	-1.382	-1.167	Fixed coefficient
0.088			0.085			R^2 McFadden

bank loan collateral						independent variable
significance level	t-statistic	regression coefficient	significance level	t-statistic	regression coefficient	variable
64.196			62.681			The probability ratio statistic
0.000			0.000			A significance level of the model
(0.280) 9.790			(0.639) 6.075			Hosmer-Lemshow statistic
(0.104) 15.868			(0.325) 11.430			Andrews statistics

The results of the second hypothesis test in the research on bank loan non-payment risk criteria for measuring bank loan contracts in Table 9 indicate that the application of the modifier variable of disclosure quality affects the independent variable of effective rate of cash tax disclosure quality (book difference of tax disclosure quality). This variable was created to test the research hypothesis. The regression coefficient value of the displayed variable suggests that, at a 95% confidence level, the interaction effect of only the book-tax difference and the quality of disclosure on the risk of non-payment of bank loans is significant. Therefore, the moderating effect of disclosure quality on the relationship between book-tax difference and the risk of non-payment of bank loans is decreasing.

Table number 9. Results of the second hypothesis test

Risk of non-payment of bank loans						independent variable
significance level	t-statistic	regression coefficient	significance level	t-statistic	regression coefficient	variable
----	----	----	0.805	0.247	0.343	The effective cash tax rate
0.662	0.437	0.590	----	----	----	Book tax difference
0.021	-2.313	-0.012	0.031	-2.162	-0.013	Disclosure quality
----	----	----	0.200	-1.281	-0.028	Effective cash tax rate Disclosure quality
0.000	-3.622	-0.072	----	----	----	Tax Book Difference Disclosure Quality
0.224	-1.216	-1.709	0.461	-0.737	-1.002	Keeping cash
0.174	1.360	0.377	0.412	0.820	0.226	Sales growth rate
0.032	2.141	1.413	0.016	0.820	1.615	Financial leverage
747/0	-0.323	-0.017	0.454	2.403	-0.039	Ratio of market value to book equity
000/0	4.948	2.440	0.000	-0.749	2.722	Property, machinery, and equipment
0.630	-0.482	-0.499	0.190	5.572	1.220	Rate of return on assets
0.063	-1.862	-0.111	0.050	-1.959	-0.115	Company size
0.820	0.228	0.226	0.781	0.278	0.275	Fixed coefficient
0.079			0.066			R^2 McFadden
71.476			59.672			The probability ratio statistic
0.000			0.000			A significance level of the model
(0.173) 11.536			(0.581) 6.596			Hosmer-Lemshow statistic
(0.117) 15.435			(0.728) 6.973			Andrews statistics

Conclusions and suggestions

This research examines the impact of tax avoidance on bank loan contracts, focusing on the disclosure quality variable in companies listed on the Tehran Stock Exchange. The evidence for both the measurement criteria of tax avoidance and the four criteria of bank loan agreements shows a statistically significant and negative relationship between tax avoidance and bank

loan agreements at the 95% confidence level. When the effective rate of cash tax was used as a measure of tax avoidance, it had a negative and significant effect on all four criteria of a bank loan (structure, cost, collateral, and risk of non-payment). On the other hand, when book difference was considered as tax avoidance, it had a positive and significant effect on all four bank loan criteria.

These results suggest that the effective cash tax rate and book difference are inverse and direct measures of tax avoidance, respectively. In other words, as the effective cash tax rate increases (book-tax difference decreases), tax avoidance decreases (increases), leading to a decrease (increase) in bank loan contracts. This demonstrates the positive and significant impact of tax avoidance, even when considering the effective cash tax rate. The findings from the first main hypothesis align with Blady et al. (2018), contradicting the results of Khodamipour and Amininia (2012) and Kim et al. (2010) which showed no relationship between tax avoidance and the cost of debt.

Furthermore, the results indicate a statistically significant relationship between the interactive variable of tax avoidancedisclosure quality and bank loan contracts, particularly in some measurement criteria of these two variables. When using the effective rate of cash tax as a measure of tax avoidance, the moderating effect of disclosure quality was confirmed on the relationship between the effective rate of cash tax and bank loan contracts in terms of structure, cost, and collateral. The presence of disclosure quality in listed companies was found to amplify the negative effect of the effective cash tax rate on bank loan contracts in these areas.

On the other hand, when book difference was considered as tax avoidance, the presence of disclosure quality only affected the relationship between tax book difference and bank loan contracts in terms of structure, cost, and risk of loan non-payment. The presence of disclosure quality reduced the positive impact of tax book difference on bank loan contracts in these areas. These findings are consistent with internal research by Dianthi Dilmi et al. (2014) and external research by Hassan and Sang (2014) and Hope et al. (2018).

In conclusion, the moderating effect of the disclosure quality variable on the relationship between tax avoidance and bank loan contracts varies depending on the measurement criteria used. The results of this study shed light on the complex relationship between tax avoidance, disclosure quality, and bank loan contracts, offering valuable insights for companies listed on the Tehran Stock Exchange.

Based on the theoretical and experimental background, as well as the research findings, it is recommended that investors pay close attention to the ranking of disclosure quality of companies as reported by the Securities & Exchange Commission when making investment decisions. Creditors and financiers should first assess a company's level of tax avoidability and review its bank loan contracts to ensure the ability to repay principal and interest, adjusting debt contracts accordingly. When making tax decisions, managers should consider tax costs versus investment costs. By disclosing financial statements and transparent, high-quality reports, and achieving a high ranking in stock exchange ratings, they can mitigate the negative effects of tax avoidance. This will also help secure bank loan contracts. The country's tax affairs organization should consider bank loan contracts as an indicator of tax avoidance when reviewing tax declarations and the taxable income of companies.

Furthermore, it is recommended that future research explore various criteria for measuring disclosure quality, such as profit predictability, profit smoothing, and other accounting literature criteria, like those in Tesla et al.'s (2018) study. Researchers should also investigate the impact of tax avoidance on different aspects of bank loan contracts, including maturity and potential crimes, as well as the influence of corporate governance variables on the relationship between tax avoidance and bank loan contracts.

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The Effect of Business Risk Management on Financing Cost by Considering the Managers' Ability

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Abstract

Objectives: The benefits of risk management can be defined as increasing efficiency and effectiveness, facilitating and streamlining, reducing costs, speeding up operations, improving communication, ensuring system control, identifying project-related threats, and helping achieve goals on time. Therefore, recognizing the need for comprehensive risk management in all firms, this research is dedicated to addressing issues in financing firms within the competitive market. This study aims to investigate the impact of business risk management on financing costs while considering managers' abilities.

Design/methodology/approach: The statistical population of the research consists of firms listed on the Tehran Stock Exchange from 2013 to 2022. Through the systematic elimination screening method, 132 firms were selected as the final sample for the research.

Findings: The findings revealed that risk management has an inverse effect on financing costs and moderates the relationship with managers' abilities.

Innovation: This research contributes new evidence to the existing literature on the topic. The results of this study can assist financial information users in making informed decisions.

Keywords: Financing costs, Business risk management, Ability of managers.

1. Introduction

Firms and economic institutions require appropriate and timely financing for investment, debt repayment, and increased working capital. Financial managers always strive to enhance the company's value by developing new financing methods. To determine the suitable financial resources, company managers should assess the costs of various financing sources and their impact on the efficiency and operational risk of companies. Companies often utilize multiple resources to implement their plans and address issues (Feng and Wu, 2023). Financing through debt is generally favored due to tax savings and lower rates compared to shareholders' expected returns. However, the crucial factor for creditors is the ability to repay. Other benefits of debt include management commitment to effectiveness, engaging creditors for monitoring, and assessing the company's ability to repay debts. Conversely, the cost of debt can indicate financial weakness and pressure, reflecting conflicts between managers, investors, and creditors (Aksoy and Yilmaz, 2023).

Companies require additional financing when prioritizing between investing domestic cash and domestic versus foreign financing costs. One of the primary reasons for companies facing financial crises and bankruptcy is their failure to meet debt obligations on time (Salehi et al., 2017). A financial crisis occurs when a company cannot secure adequate financial resources to sustain operations (Venkateswarlu et al., 2022; Salehi et al., 2016). Given the economic challenges, internal and external threats, and risks companies encounter, as well as the issues related to the cost of external financing, it is essential to address how companies can navigate these challenges (Kardan et al., 2016). Bringing commercial credit levels close to optimal amidst macroeconomic shocks and internal risks is crucial (El-Chaarani and Abraham, 2022).

Effective risk management by capable managers can help companies adjust operational and economic costs, make informed decisions, and identify control factors to enhance security and achieve organizational goals (El-Khatib et al., 2022). Risk management contributes to increasing efficiency, streamlining operations, reducing costs, improving communication, ensuring system control, identifying project-related threats, and meeting goals promptly (Liu and Huang, 2022). By managing risks adeptly, companies can create conditions for financing at lower costs and attract commercial credit (Foli et al., 2022). This raises the question: does risk management impact financing costs? The research structure will delve into the theoretical foundations, hypotheses, and empirical foundations, followed by methodology, operational definitions of research variables, and ultimately, the research findings and conclusions.

Managers play a pivotal role as decision-makers in overcoming financial crises and addressing financing costs (Yung and Chen, 2018; Salehi et al., 2019). Failure to manage effectively is a common reason for business failures and financial crises. Proper management entails reacting to situations and crises promptly. Publicly available information can shed light on the personal characteristics of managers. To secure appropriate financial resources, company management must evaluate the costs of providing financial resources and their impact on risk and return (Salehi et al., 2020). Lack of experience, management skills, influence, and timely initiative can jeopardize a company's survival. Incompetent management may result in failure to adapt to market changes, over- or under-development, insufficient sales, improper pricing, high overhead costs, over-investment, etc. (Anggraini and Sholihin, 2023; Faysal et al., 2020).

A competent manager can indirectly leverage high experience, updated knowledge, expertise, and industry-specific skills to navigate the bridge between management, risk, and financing costs. This raises the question: do managers' characteristics influence the relationship between financial crises and financing costs? Prev

ious research has explored various financing methods and their influencing factors. For instance, Tran (2022) found that foreign ownership negatively impacts debt costs, especially in non-governmental companies with financial constraints. AlKhouri and

Suwaidan (2023) discovered no effect of overall social responsibility disclosure on financing costs. Kong (2023) studied the impact of China's family businesses' ESG performance on debt financing costs, revealing that strong ESG performance can reduce debt financing costs. However, the impact of risk management on financing costs remains unexplored. Addressing this research gap, the present study aims to investigate this relationship. The research structure will cover the theoretical foundations, hypotheses, empirical foundations, methodology, operational definitions of research variables, and finally, the research findings and conclusions.

2. Theoretical, Experimental Issues and Hypothesis Development

Firms require appropriate and timely financing for investment, debt repayment, and working capital increases. Financial managers constantly strive to enhance company value by developing new financing methods. To determine suitable financial resources, company managers should assess the costs of various financing sources and their impact on company efficiency and operational risk. Companies typically utilize multiple resources to execute their plans and address issues (Guney et al., 2011). Huang et al. (2018) investigated factors related to company financing in French companies during the global financial crisis. They discovered that small firms, during global crisis conditions, rely more on internal financing sources and may sell tangible or non-essential assets to focus on core competencies and reduce intangible assets. While there may not be a perfect financial program to maximize company value, understanding how financial markets operate can provide some guidance. Guney et al. (2011) explored the relationship between competitive flexibility and financing methods in China and found a significant correlation. Their results also indicated that financing decisions are influenced by industry type, company size, and growth stage. Company managers should carefully evaluate the costs and effects of various financing sources on efficiency and operational risk (Yazdan Far and Ohman, 2015). Tran (2022) demonstrated that foreign ownership negatively impacts debt costs, especially in non-governmental companies and those facing financial constraints. AlKhouri and Suwaidan (2023) found that overall social responsibility disclosure does not affect financing costs. However, companies that lack transparency and engage in socially responsible activities related to the environment and human resources are viewed as high-risk by market participants, leading to higher financing costs. Profit-seeking companies involved in social responsibility activities also face increased risk. Francis et al. (2017) studied the link between auditor changes and bank financing costs. Their findings suggest that voluntary auditor changes heighten information risk, which is reflected in private credit markets. The presence of various securities, along with specific criteria and factors, determines the acquisition of necessary resources. These factors dictate the type of resources suitable for a company based on its condition, economic factors, industry status, size, ownership, and other relevant factors. Managers must strike a balance between debt and equity to create an optimal resource mix. It is essential to consider the advantages and disadvantages of different financial resources, as each has its own set of pros and cons (Vanacker et al., 2010). Organizations in the business environment constantly face risks, which can impede performance and hinder sustainable growth (Salehi et al., 2020). By effectively managing risks, companies can enhance sustainable performance (Huston et al., 2011). Malik et al. (2020) affirmed that organizational risk management significantly and positively impacts company performance. They recommended that board oversight be robust and that risk management be integrated with board functions. A sound board structure can effectively demonstrate risk management practices. Risk management involves identifying and evaluating risks, followed by developing strategies to mitigate them. Financial risk management focuses on risks associated with financial and business instruments, while intangible risk management deals

with human capital risks like knowledge, relationship, and operational process risks (Salehi and Ghasempour, 2021). Large companies typically have dedicated risk management teams, while smaller entities manage risks informally (Gordon et al., 2009). Sunday et al. (2020) highlighted a significant relationship between liquidity risk management and financial performance, recommending that companies integrate liquidity risk management into their financial strategies. Given the significance of consumer goods and their impact on consumers, companies should establish risk committees to swiftly manage risks and fluctuations. Identifying and managing risks is crucial for economic stability. Cao et al. (2021) explored the link between risk management, corporate social responsibility, managerial trust, and real activity income management. They found that companies with effective risk management are more inclined to engage in socially responsible practices. Managerial trust influences corporate policies and can mitigate overall risk effects on social responsibility. Confident CEOs with higher stakes tend to increase CSR activities to bolster corporate reputation by reducing earnings management. Optimal risk management involves prioritizing risks based on potential losses and probability of occurrence, addressing high-loss, high-probability risks first. However, balancing high-probability, low-loss risks with low-probability, high-loss risks can be challenging (Wong, 2014). Aprilia et al. (2022) reported that risk management positively impacts company value, while leverage has a negative effect. Risk management does not moderate the relationship between managerial ownership, leverage, and company value. Effective risk management can prevent future risks by anticipating and controlling potential events. Risk management, as defined by the Association of Chartered Accountants of Iran, involves responding to and investigating project crises and threats, identifying and analyzing potential obstacles before they occur, and developing pre-designed solutions to address them effectively (Middle and Rosok, 2021). Masanja (2022) found that audit committee characteristics, supervisory processes related to risk management, and management support contribute significantly to the effectiveness of risk management. Risk assessment can be complex, requiring detailed analysis of project schedules, financial data, security protocols, sales forecasts, and other relevant information. Risk assessment is crucial for project planning, cost control, and reliability. Identifying potential risks, reducing risks, making informed decisions about crises, and planning for projects are central to effective risk management (Crawford and Nilsson, 2021). Risk assessment and management are essential tools for addressing project obstacles and threats, ultimately reducing costs associated with overcoming crises. Companies facing financial constraints or critical situations are viewed as high-risk by financiers, leading to higher financing costs. Effective risk management can help secure more favorable financing terms. Therefore, the first hypothesis of this research is as follows:

H1: Business risk management is effective in reducing financing costs.

In today's world, management plays a crucial role in increasing the efficiency and productivity of companies. Among the four key success factors in organizations, including workforce, capital, raw materials, and management, the role of management has become more important than ever before (Varma et al., 2020). Management is considered the most important strategy for developing and updating human and organizational resources, thereby increasing productivity. For organizations to be successful and avoid bankruptcy, they must stay ahead of their competitors rather than fall behind. Therefore, management efficiency is a significant concern in economic units. Managers and business unit officials strive to promote economic progress and development within the business unit by investing in various fields and preventing stagnation and backwardness (Baik et al., 2020).

Franco et al. (2018) stated that this paper examines the impact of borrowers' managerial ability on lenders' bank loan pricing and the channels through which managerial ability affects bank loan pricing. Using a

large sample of US bank loans, we provide evidence that higher managerial ability is associated with lower bank loan prices. This effect is more pronounced in firms with high information risk, suggesting that an important channel for managerial ability to influence bank loan pricing is through improved financial disclosure to mitigate information asymmetry.

According to the theory mentioned above, the personal characteristics of managers play a crucial role in their strategic decisions, and significant choices in the company stem from the intrinsic characteristics of decision-makers, including the CEO. One of the main topics of stakeholder theory relates to managers' perspectives on management and how to operate a company. In this theory, the role of management leadership is considered crucial as it involves making strategic decisions. Since the CEO's decisions shape the leadership activities of managers, it is reasonable to expect the CEO to have a major influence on company matters (Putra, 2023).

Choo et al. (2021) mentioned that their research examines the connection between managerial ability and firms' external financing. Their findings indicate that firms with more capable managers tend to reduce information risk by decreasing their loan financing and increasing equity financing. Zahid et al. (2023) stated that the authors' findings align with management signaling and reputation enhancement theories, showing that managerial skill is linked to higher debt financing. Managers with strong management skills are more likely to secure debt financing, as they can anticipate their companies' economic future and effectively communicate private information, reducing information asymmetry and enhancing their reputation. From this perspective, how a company responds to risk and risk management serves as a test of management's ability to impact investment performance. Effective risk management within a business unit can create a competitive advantage. By establishing a competitive advantage, risk management techniques can be expected to play a crucial role in boosting productivity and ultimately reducing the company's financing costs, despite capable management. Therefore, the second hypothesis of the research is presented as follows:

H2: Managers' ability to effectively affects the relationship between business risk management and financing costs.

3. Research Methodology

The research presented is of the applied type. In terms of methodology, the statistical population includes all listed companies on the Tehran Stock Exchange from 2013 to 2022. Through systematic elimination, companies that met specific conditions were selected as the final sample. For comparability, the financial year chosen by the company is the end of March, and they must have maintained the same financial year for a period of 10 years. Additionally, the companies should not be banks, insurance, or investment companies. By applying these conditions, 132 companies were included in the final screening from the statistical population.

The information of the sample firms was analyzed using the combined panel data method and the Eviews 12 software. The powerful standard error tool was utilized for the final testing of the hypotheses. The combined data, incorporating time and place in different periods, provided comprehensive and reliable information to the researcher. Regression analysis, using the powerful standard error tool, was deemed the best option for investigating the relationships in the current research.

Table 1. The screening of the statistical population

The statistical population in 2022		577
Deductible: inactive companies	-193	
Deductible: Companies that have stock trading suspension	-37	
Deductible: Companies that have changed the financial period	-67	
Deductible: Companies that entered the stock market during the research period	-99	
Deductible: investment companies, banks, and holdings	-49	
The final sample of the research		132

3.1. Operational Definitions of Research Variables

3.1.1. Dependent Variable: Financing Cost (CD)

The cost of financing is a crucial factor in managerial and financial decision-making. Managers need to be aware of the costs associated with the financial sources they utilize. In this study, based on research by Yazdan Far and Ohman (2015), debt financing is examined and measured using the following ratio:

Financing cost = (financing cost / total debts)

3.1.2. Independent Variable: Risk Management (ERM)

Gordon et al.'s (2009) model has been used to measure risk management. These factors have been identified based on their ability to achieve the set goals of the companies and are as follows:

$$ERMI_{i,t} = \beta_0 + \beta_1 EU_{it} + \beta_2 CI_{it} + \beta_3 FS_{it} + \beta_4 FC_{it} + \beta_5 MBD_{it} + \varepsilon_{it}$$

In the above model, these are ERMI (risk management indicators), EU (environmental uncertainty), CI (industry competition), FS (firm size), FC (firm complexity), and MBD (board supervision). In the above model, Ɛ is the error component of the model, which indicates the deviation from the best model proposed by Gordon et al. (2009), in such a way that the lower the error component of the model is, it indicates the high-risk management of the company and vice versa. For this purpose, the absolute value of the model error has been taken and multiplied by a negative number, and it is defined as risk management

3.1.2.1. Risk Management Indicators (ERMI)

The Committee of Sponsoring Organizations of the Treadway Commission (COSO), used the following four indicators to manage organizational risk and internal control to improve organizational performance and better governance and reduce the amount of fraud in organizations.

$$ERM_I = \sum_{k=1}^{2} Strategy + \sum_{k=1}^{2} Operation + \sum_{k=1}^{2} reporting + \sum_{k=1}^{2} Compliance$$

3.1.2.1.1. Strategy

Refers to the methods adopted by companies to stay in competitive market conditions. In this case, the company tries to maintain its competitive status compared to other companies active in this field. To measure the competition strategy, the following two relationships can be used, which are calculated as follows:

$$Strategy_1 = \frac{Sales_{it} - \mu Sales}{\sigma Sales}$$

In the above model, Sales (company sales), μSales (average industry sales), and σSales (standardized sales of companies in the industry) are:

$$Strategy_2 = \frac{\Delta\beta - \mu\Delta\beta}{\sigma\Delta\beta}$$

In the above model, Δβ (the beta of the company in year t minus the beta of the company in year t-1), μΔβ (the average beta of the industry), and σΔβ (the standard deviation of Δβ of all companies in the industry).

3.1.2.1.2. Productivity (Operation)

Productivity is measured as the relationship between the company's inputs and outputs in the company's operation process. Any amount of the company's output at a certain level is more than the inputs, showing the company's better performance. To measure productivity, the following two relationships can be used:

$$Operation_1 = \frac{Sales}{Total\ Assets}$$

$$Operation_2 = \frac{Sales}{Number\ of\ Employees}$$

In the above model, Sales is the Number of Employees.

3.1.2.1.3. Reporting Risk Management

Following Gordon et al. (2009), reporting refers to the level of trust in the company's reporting because correct reporting guarantees the survival and success of the organization. To measure this factor, the modified Jones model measures the total value of discretionary and non-discretionary accruals. The reason for using both factors of accrual items (optional and non-optional) is that both items can be negative, so their relative strength is more reliable.

Reporting1= (non-optional accrual of absolute value items)/ (non-optional absolute value + optional accrual of absolute value items)

In this model, the total accrual items are calculated first, which is the result (net profit minus operating cash), and after calculating the total accrual items, parameters α_1, α_2, and α_3 continue through the following model to determine the total non-discretionary accrual items:

$$TA_{i,t} /A_{i,t-1} = \alpha_1(1/A_{i,t-1})+\alpha_2(\Delta REV_{i,t} - \Delta REC_{i,t}) /A_{i,t-1} +\alpha_3(PPE_{i,t}/A_{i,t-1})+\varepsilon_{i,t}$$

Where TA (total accrual items), ΔREVi,t (change in sales revenue of the current period compared to the previous period), ΔRECi,t (change in accounts receivable of the period compared to the previous period), PPEi,t (gross property, car tools, and equipment), Ai,t-1 (the book value of the assets of the previous period) and εi,t (the uncertain effects of the company's random factors). After calculating α1, α2, and α3 parameters through the least squares method, according to the following formula, non-discretionary accruals (NDA) are determined as follows:

$$NDA_{i,t} = \alpha_1(1/A_{i,t-1})+\alpha_2(\Delta REV_{i,t} - \Delta REC_{i,t}) /A_{i,t-1} +\alpha_3(PPE_{i,t}/A_{i,t-1})+\varepsilon_{i,t}$$

And finally, discretionary accruals (DA) after determining the NDA are calculated as follows:

$$DA_{i,t} = (DA_{i,t} /A_{i,t-1}) - NDA_{i,t}$$

Reporting2= (Material Weakness) + (Auditor Opinion) + (Restatement)

In the above model, Material Weakness (equal to the number of clauses announced in the independent auditor's report), Auditor Opinion (if the auditor's report is acceptable, the number will be 1; otherwise, it will be zero), Restatement (representation of financial statements (in case of renewal) (Provide one; otherwise, it will be zero).

3.1.2.1.4. Compliance

Increasing compliance with laws and regulations will reduce risk and increase company value. Adhering to the audit standards will require the acceptance of audit costs. According to the research (Gordon et al. 2009), the following two relationships can be used to measure the compliance variable (audit costs are extracted from the profit and loss statements of companies):

Compliance1= (cost audits)/(companies total assets)

Compliance2= (net (loss) profit)/(companies total assets)

3.1.2.2. Environmental Uncertainty Factor (EU)

Environmental uncertainty can be seen as an increase in future unpredictable events. This environmental uncertainty can cause many problems for organizations. Financial reporting and performance measurement are more complicated in companies with variable and highly volatile business operations. Risk management, as a subset of the management control system, aims to identify and manage uncertain future company events. Therefore, environmental uncertainty can influence risk management (Gordon et al., 2009).

Three parameters are used to measure this factor:

a) Sales change factor ((Sit)CN), b) capital cost change factor, c) change factor of net profit before tax ((Iit)CV), and Iit is net profit before tax of the

company in year t. Using the above three parameters, environmental uncertainty is obtained as follows:

a) $EU = Log\ (\sum_{k=1}^{3} CV(X_k))$

b) $CV(X_k) = \frac{\sqrt{\frac{\sum_{t=1}^{11}(Z_{k,t}-\bar{Z}_k)}{n}}}{|\bar{Z}_k|}$

In the above relationship, CV(Xk) is the coefficient of uncertainty changes, t (years of research), Xkt (uncertainty k in year t), and Zk (average changes of uncertainty k during n years).
3, 2, and 1 = K for uncertainty 1) Coefficient of changes in sales 2) Coefficient of changes in capital cost 3) Coefficient of changes in net profit before tax.
The weighted average method of the cost of capital is used to calculate the cost of capital.

$$K_S = \frac{D_0(1+g)}{P_0} + g$$

Where D0 (equals cash profit per share in the current period), P0 (share price at the beginning of the year), and g (dividend growth rate).

3.1.2.3. Industry Competition (CI)

Industry competition measures industry concentration, where low concentration means high competition. Due to the intense competition between competing companies, each company tries to adopt the appropriate strategy to surpass other competitors, so there will always be a risk of not being sustainable for companies (Gordon et al., 2009).

$$CI = 1 - \sum_{i=1}^{n} \left(\frac{S_{it}}{TotalS_{st}}\right)^2$$

In the above model are CI (market share), Sit (sales of each company in year t), and Sst (industry sales in year t).

3.1.2.4. Firm Size (FS)

The relationship between firm size and organizational structure has been considered in the organizational theory literature. The natural logarithm of total assets has been used to measure this factor.

3.1.2.5. Firm Complexity (FC)

Firm complexity reduces information integration and more problems in the internal control system, so strong organizational risk management is needed to reduce complexity (Gordon et al., 2009). Cost complexity is one of the components of company complexity; cost complexity is defined as the extent to which revenues cover costs. In organizations with less cost complexity, costs move proportionately to revenues, so profits are easily determined according to anticipated revenue changes. If costs do not change in line with revenue, then understanding what drives revenue forecasting cannot help forecast profit. As a result, cost complexity will likely affect predicting performance, all else being equal. Therefore, cost complexity is measured through the relationship between revenues and earnings before interest and taxes.
FC = -1 CORREL (revenues & earnings)

3.1.2.5. Board Oversight (MBD)

The board oversight variable is calculated and measured by dividing the number of board members by the logarithm of sales.

3.1.3. Research Moderator Variable: Management Ability (MA)

Demirjan et al.'s (2012) model is used to measure managers' abilities. After performing the regression test, management efficiency is determined through the residual value (ε_t) in each year-company as follows: calculated through the residual of the regression model, a positive residual means high efficiency, and a negative residual means less efficient management.
Demirjan et al. (2012) calculated the results of managers' ability using a series of data envelopment analyses, and this data analysis is based on a series of optimizations using linear programming, also referred to as a non-parametric method. Demirjan et al.'s 2012 model will be used in this research to measure management ability. Coverage analysis is used through equation 1 to measure the company's efficiency.

$$max_v \theta = \frac{Sales}{v_1 CoGS + v_2 SG\&Av_3 NetPPE + v_4 OpsLease + v_5 R\&D + v_6 Intan}$$

Table 2. Definition of the variables used in the above equation

Model input	Variable	Sign	Operational definition
Output variable	Sales	Sales	The amount of company sales
Input variables	Cost	CoGS	The total cost of goods sold
	Net fixed assets	NetPPE	Net property, machinery, and equipment
	Operating lease cost	OpsLease	The financial statements do not identify research and development costs and information related to rents, so the effects of these two variables are removed from the models.
	Research and development costs	R & D	
	Intangible assets	Intan	Net intangible assets

The calculated value for the company's efficiency will be in the range of zero to one. Companies whose efficiency score is less than one are below the efficiency frontier and must reach the efficiency frontier by reducing costs or increasing revenues. The purpose of calculating the company's efficiency is to measure the management's ability, and since the inherent characteristics of the company are also involved in the calculations related to the efficiency, it is not possible to measure the management's ability correctly because affected by these characteristics, it is calculated more or less than the real value.

Demarjian et al. (2012), to control the effect of the inherent characteristics of the company in the model they presented, have divided the company's efficiency into two separate parts, i.e., efficiency based on the inherent characteristics of the company and management efficiency. They have controlled five firm characteristics (firm size, market share, cash flow, acceptance life on the stock exchange, and foreign sales (exports). The five variables, intrinsic firm characteristics, can affect management and help to make better decisions or act in the opposite direction, limiting management's ability.

These five features are controlled in the model presented by Demarjian et al. (2012):

$$Firm\ Efficiency_{j,t} = \alpha_0 + \alpha_1 Size_{j,t} + \alpha_2 Marketshare_{j,t} + \alpha_3 FreeCashFlowIndicator_{j,t} + \alpha_4 Age_{j,t} + \alpha_5 ForeignCurrencyIndicator_{j,t} + \varepsilon_{j,t}$$

Where

Sizej,t = is the size of company j in year t and is equal to the natural logarithm of the company's total assets.

MSHj,t = the market share of company j in year t and is equal to the ratio of the company's sales to the total industry sales.

FCFIj,t = shows the increase (decrease) in the operating cash flow of company j in year t, which is equal to one if the operating cash flow is positive and zero if it is negative.

Agej,t = is company j's life in year t and is equal to the natural logarithm of the number of these years.

FCIj,t = The export of company j in year t; for companies that have exported, it is considered equal to 1 and, otherwise, zero.

εj,t = the remainder of this pattern indicates the level of management ability.

3.1.4. Research Control Variables

According to various studies in the field of financing, such as Aksoy and Yilmaz (2023), the following variables have been applied to control unwanted factors in the research model.

Return on assets (ROA): Net profit divided by total assets

Stock return rate (RET): equivalent to the closing price of a share minus the first-period price and any cash dividends divided by the first-period price.
Company size (SIZE): natural logarithm of total assets
Growth: Sales revenue minus the sales of the previous period divided by the sales of the previous period
Cash: the ratio of operating cash to total assets
Financial Leverage (LEV): The ratio of the total liabilities of the company to the total assets of the company at the end of each financial period.

3.2. Regression Model of Research

$$CD_{it} = \beta_0 + \beta_1 ERM_{it} + \beta_2 MA_{it} + \beta_3 ERM_{it} \times MA_{it} + \beta_4 MB_{it} + \beta_5 ROA_{it} + \beta_6 SIZE_{it} + \beta_7 CASH_{it} + \beta_8 Growth_{it} + \beta_9 LEV_{it} + \varepsilon_{it}$$

4. Research Findings

4.1. Descriptive Statistics of Research Variables

Table 3 shows the descriptive statistics of the research variables. Descriptive statistics show the amount of data dispersion, and mean, and standard deviation are two important factors in descriptive statistics. The above table shows that the average financial leverage is (0.55), which shows that most of the data is around this point. The highest standard deviation is related to company growth (3.58), and the lowest is related to financing costs (0.042). The highest and lowest also show the highest and lowest in each variable among the research sample.

According to the results obtained in Table 3, the significance level of the variables in the significance test is less than 5%, indicating the variables' significance.

Table 3. Descriptive statistics of research variables

Variable	Mean	Max.	Min.	Standard deviation	Skewness	Kurtosis
CD	0.056	0.150	0.000	0.042	0.620	2.610
ERM	-0.610	-0.010	-1.800	0.450	-0.720	2.720
MA	0.007	0.370	-0.330	0.120	-0.069	3.240
Cash	0.046	0.280	0.002	0.048	2.053	7.850
Growth	0.347	1.653	-0.360	0.420	0.863	3.850
LEV	0.559	0.975	0.104	0.203	-0.146	2.400
ROA	0.143	0.594	-0.289	0.155	0.566	3.450
SIZE	14.720	19.770	11.300	1.534	0.798	3.880
MB	4.220	14.290	1.010	3.580	1.600	4.700

Table 4. Stationary test (Levin, Lin, and Chu) of research variables

Variable	Test statistic	Significance level	Result
CD	-25.374	0.000	Stationary
MA	-21.758	0.000	Stationary
ERM	-25.146	0.000	Stationary
Cash	-4.354	0.000	Stationary
Growth	-9.408	0.000	Stationary
LEV	-2.514	0.006	Stationary
ROA	-14.298	0.000	Stationary
SIZE	-5.175	0.000	Stationary
MB	-17.455	0.000	Stationary

Table 5. Classical regression hypothesis tests

Variable	Test statistic	Sig
Cost of financing	4.077	0.000
Management ability	266.800	0.000
Risk management	190.320	0.000
Cash holding	61.550	0.000

According to the results obtained in Table 4, the F-Limer test with a significance level below 5% (0.000) has confirmed the panel data pattern, which is further observed by observing the Hausman test coefficient with a significance level below 5% (0.000) confirming the model with fixed effects of width from the origin. The test of heterogeneity of variance and serial autocorrelation with a significance level below 5% shows that there was heterogeneity of variance and serial autocorrelation in the model, which has been removed in the final estimation by using the standard error tool facilities in EViews Software, and the need It was not due to other actions.

4.2. The Result of the Research Hypothesis Test

The results of Table6 show that risk management has an inverse and significant relationship with the speed of adjusting companies' commercial credit, with a negative coefficient (-3.42) and a significance level below 5% (0.001). Therefore, the first research hypothesis is not rejected at the 5% error level. In addition, the interaction of risk management and the ability of managers with a negative coefficient (-0.18) and a significance level below 5% (0.001) has an inverse effect on the cost of financing. Therefore, the second research hypothesis is accepted at the 5% error level. Also, the control variables of liquidity and financial leverage affect the dependent variable at the error levels of 5 and 10%. The coefficient of determination equals 0.37, which shows that the independent and control variables inside the model cover 37% of the changes in the dependent variable. Watson's camera is equal to 1.57, and since our number is between 1.50 and 2.50, it shows no strong autocorrelation between the sentences of the disturbance model. The collinearity statistic is less than 5, showing no strong correlation between the research variables. The test statistic (F) with a significance level below 5% shows that the research model fits well.

Table 6. The results of the research hypothesis test

Variables	Coefficients	Standard error	T statistic	Sig	VIF
ERM	-3.420	1.050	-3.260	0.001	1.00
MA	0.013-	0.004	-2.640	0.008	1.11
ERM × MA	-0.180	0.058	-3.230	0.001	1.00
MB	0.190	0.260	0.720	0.470	2.43
ROA	0.008	0.031	0.250	0.790	1.38
SIZE	0.100	0.087	1.230	0.210	1.82
Cash	0.002	0.000	3.080	0.002	1.20
Growth	0.021	0.015	1.420	0.150	1.10
LEV	0.200	0.015	1.770	0.076	1.33
AR(1)	0.250	0.140	1.840	0.065	-
Intercept	4.610	2.070	2.210	0.026	-
coefficient of determination		0.370			

Variables	Coefficients	Standard error	T statistic	Sig	VIF
Durbin-Watson		1.570			
F statistic		5.016			
Sig		0.000			

5. Discussion and Conclusion

This research aims to investigate the effect of business risk management on financing costs by considering the role of managers' abilities. The cost of financing for companies is always increasing, and companies should consider the lowest cost of capital for financing to obtain the highest profit and return on shareholders' capital. Debt financing is less risky for investors because the lender's expected interest rate is lower than the shareholder's expected rate of return, and also because, according to tax regulations, the interest cost is an acceptable tax expense. This causes the company to pay less tax and is considered a more favorable solution for financing. In other words, tax savings from using this source make it cheaper and increase the shareholders' profits. However, more is needed to maximize the profit of the target shareholders; the degree of risk or uncertainty regarding the profit paid to the shareholder should also be considered.

A company that uses a significant amount of loans commits to paying a fixed interest on its profit, the achievement of which is uncertain because it is impossible to predict how much profit the company will have in the future. In contrast, the company is committed to a fixed interest rate. In this case, the profits of the shareholders will fluctuate a lot. On one hand, the shareholder is happy that the company gets the desired loan because the expected profit increases, and on the other hand, they are worried about the risk to their profit. The shareholder is still determining if they will get the maximum profit. In the event of an excessive increase in debt, the high risk will cause the value of the company's shares to decrease. Therefore, at the same time as financing, it is necessary to pay attention to documented risk management programs. By forming a risk committee, threats can be turned into opportunities with specialized teams because risks and dangers in the competitive market are integral parts of the market. Companies should follow the written programs of risk management and deal with risks by forming risk committees and using experts so that they can satisfy investors with a lower cost of financing.

The results obtained are similar to the research results of Aksoy et al. (2023) and Yilmaz (2022). By identifying risks and forming a risk committee, companies should provide the basis for improving productivity, lowering financing costs, and helping in this field by using capable managers. Future researchers are suggested to examine the research topic in various industries to determine the various aspects, and they can also examine the level of risk management and the level of shareholders' loyalty.

Practical suggestions

The vital role of managers in the survival of businesses is evident, as they are the final decision-makers with high capabilities and a wealth of information, knowledge, experience, expertise, and qualitative attributes. In many cases, managers can pave the way for achieving corporate sustainability by creating competitive advantages over competitors. Capable managers are crucial for the survival of an organization and an economic enterprise, as their decisions can result in significant profits or losses for shareholders. Therefore, it is recommended to encourage the use of risk management strategies in organizations. Company owners can reap greater benefits by hiring capable managers who utilize risk management programs to lower financing costs and increase the company's share value. Introducing new training courses on risk management can be an effective way for stock exchange organizations to promote this practice among companies. Stock exchange organizations should mandate that

companies disclose detailed risk management plans, ultimately leading to the widespread adoption of such plans.

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Advanced Algorithms for Designing and Creating Optimal Portfolios

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Abstract

Objectives: Achieving sustained and long-term economic growth requires efficient resource allocation. This research aims to enhance optimization methods based on Sharpe Ratio performance and introduce an intelligent trading method utilizing various algorithms.

Design/methodology/approach: A quantitative investment model is developed using the Momentum Algorithm and a long-term investment model over a six-year horizon. The model is applied monthly from 2019 to 2023 within the stock exchange framework. Additionally, a series of smart models (Overall Functions, Overall Mean, and Overall Algorithm with Kalman Filter) are created to determine capital amounts using intelligent patterns.

Findings: The findings demonstrate that the proposed structure outperforms conventional algorithms, indicating it can serve as a viable alternative for achieving superior investment outcomes.

Innovation: This research contributes to the existing literature by introducing advanced optimization techniques that leverage intelligent algorithms for trading strategies. The findings provide new insights into capital allocation efficiency and risk management in financial markets.

Keywords: Smart Portfolio, Momentum Algorithm, Kalman Filter, Kelly Creation.

1. Introduction

In recent years, numerous scientific activities have been conducted to educate the public on the analysis of financial markets and encourage them to invest and operate in these markets around the world. However, most traders are unable to use scientific analysis in transactions for many reasons. Therefore, there is a strong need for an automated approach to efficiently and effectively use financial data to support investment decisions (Amiri et al., 2016). One of the systems that have made significant efforts to improve is smart trading.

The key issue here is choosing the right investment strategy that results in the lowest possible risk while maximizing profits. In this research, a smart portfolio management approach is proposed to enhance existing methods. The proposed smart portfolio has a two-layer framework. In the first step, two quantitative investment models are implemented, each targeting a model over a different time horizon. Then, a set of smart models that allocate capital to quantitative models is created. The use of Kelly's criterion to create a smart portfolio is beneficial on several levels. First, it targets the patterns that occur in financial data across different time horizons, creating more reliable investment models and making better use of the data. In the second step, the maximum likelihood is calculated using Kelly's criterion at each step to determine the maximum return. Ultimately, investing in loss models is avoided, leading to a smart allocation of capital.

2. Theoretical foundations and research background

The relationship between asset return and risk has been the focus of many researchers and studies in recent decades. Such studies include the Sharpe (1964) and Black (1972) capital asset pricing models and the Fama and French three-factor model (Fama and French, 1993). Carhart introduced the four-factor model and added the momentum effect to the Fama and French models (Carhart, 1997). Other parameters, such as quality (Pietrovsky, 2000), liquidity (Einsteinbach, 2001), and volatility (Eng, Chen, and Jing, 2006), have been studied to identify additional return factors in active strategies. Technical analysis has examined the patterns of market trends and supply and demand for stocks (Achilles, 2000). Traditionally, optimization approaches have either used technical indicators (Hira Bayashi et al., 2009; Casano, 2010; Kaosik, 2012) or fundamental indicators (Hong et al., 2012) to rank shares and form portfolios to achieve greater returns (Pakizeh et al., 2017). Many different optimization methods based on metaheuristic algorithms have also been used, including simulated models (Krama and Skins, 2003), ant colonies (Dorrens et al., 2004), genetic algorithms (2008), particle swarms (Xav et al., 2011), and others.

Carlos Heitor et al. (2021) stated in a study entitled "Optimal portfolio strategies in the presence of regimes in asset return" that the approximation is shown to be fast and accurate in a four-regime setting with an allocation to four assets compared to the numerical solution developed in Guidolin and Timmermann (2007). The computation time of the approximate solution is shown to be practically independent of the number of assets when no predictors are present, and only marginally affected by the number of predictors. While the portfolio policy strongly depends on the current state of the economy, the consumption-to-wealth ratio is roughly state-independent. Predictability considerably changes the optimal portfolios. Hedging demands are negligible with regimes and no predictability, but are important with predictability. On the other hand, the consumption-to-wealth ratio is not very impacted by the predictor.

Wajid Reza and Ashraf (2018) studied the use of smart beta strategies and increased portfolio performance in Islamic investment. They stated that the introduction of smart beta strategies allows passive investors to compare the structure of equity securities using alternative strategies such as underlying weighting, equal amounts, and low-risk weighting strategies.

Saran Mehra et al. (2016) investigated the creation of smart portfolios using quantitative investment models. Using a large-scale historical dataset of stocks and indices, they showed that the K2 algorithm compares well-adjusted risks concerning Sharpe ratios, a better average price increase in comparison to average loss coefficients, and a higher probability of success in comparison to existing criteria. It also measures these indices in experiments out of sample.

Hitach and Zambrano (2016) examined the appropriate smart beta strategies for joint venture portfolios and stated that different smart beta strategies (such as weight, global variance, equal risk share, and maximum diverse risk) are presented as an alternative to index weight in the context of equity.

Chris et al. (2015) studied smart beta investment and stated that smart beta securities typically lead to a higher variety than capital market value metrics. But they still hurt the massive market downturn. Nieto et al. (2014) compared the OLS, GARCH, and Kalman filter methods on the Mexican Stock Exchange and found that the Kalman filter performs better than the other methods in estimating the beta coefficient.

Tehrani et al. (2018) performed portfolio optimization with the help of the Krill herd metaheuristic algorithm using different risk criteria on the Tehran Stock Exchange and stated that the Krill herd algorithm performs better than other conventional algorithms in finding efficient border and optimal portfolios and can be substituted for these methods to achieve better results.

Azizzadeh and Ebadi (2017) examined the choice of the optimal pair trading strategy under the statistical changes of the spread process and stated that proper investment and decision-making on the right position to buy or sell require a well-defined strategy.

Amiri et al. (2016) presented a smart trading model in financial markets based on genetic algorithms, fuzzy logic, and neural networks. In this study, they developed a smart trading system based on the well-known rules of technical analysis and the use of three tools: genetic algorithms, fuzzy logic, and neural networks.

Rahnamay Roodposhti et al. (2015) made an effort to optimize the portfolio using sustainable optimization, risk estimation, portfolio estimation, and comparison of risk and expected returns in this model with expected risk and returns in a classic model. It was found that the expected return on the portfolio in the sustainable model was not significantly different from the predicted return in the classic model, and the predicted risk in the sustainable model was not significantly different from the predicted risk in the classic model. However, by examining the return and risk of portfolios based on the weight provided by each model, it was found that the actual returns of both methods are not significantly different in the Iranian market. However, the real risk of a portfolio optimized by a sustainable model is lower than that of a portfolio optimized by the classical method.

3 Research Method

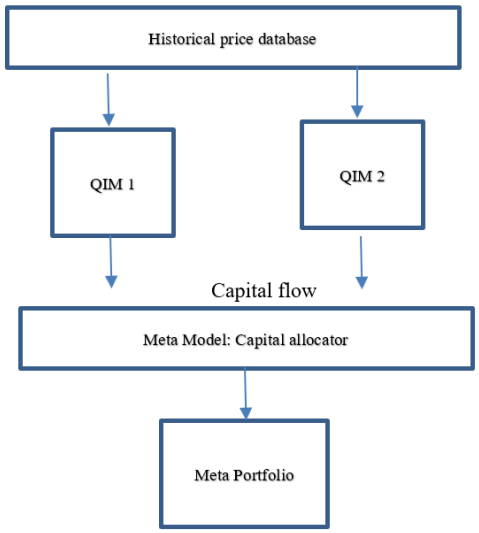
3.1. Research objectives

The purpose of this study is to integrate models that distinguish various aspects of patterns and structures in data across different time horizons: long-run models to derive acceleration models and short-run models to derive the inverse mean. The process and underlying framework can be viewed as a two-way system: at the first level, models are tailored to concentrate on a specific aspect of financial time series, these models interact with the market and make business decisions. The second level involves a model that allocates capital to the first-level models and essentially creates a portfolio of quantitative models.

3.2 Conceptual model

Two quantitative investment models and several smart models will be implemented for the present study. These quantitative models were chosen because they operate at different times and are classified as assets that move inversely in the stock market. The proposed system for making trading decisions combines technical and fundamental techniques in stock selection and portfolio formation. The parameters used in the algorithms are optimized to maximize the return

on the portfolio. The overall structure of the proposed system is as follows:



Historical Database: The database contains financial data in a time series of daily market prices, showing the high, low, and average prices per day of the dataset. These data support quantitative investment models and also aid in the analysis of all models and the daily valuation of securities.

Quantitative Investment Models: Quantitative models are simple investment methods in which the process is driven by an algorithm. Systematic and quantitative models mean that the start-up and implementation of an investment decision are completely controlled by an algorithm, eliminating human intervention.

Smart Model: The smart model involves dynamic allocation of capital. While data and analyses are updated daily, the smart model is designed to make capital allocation decisions at the end of each month.

Smart Portfolio: Represents the value of stocks in a portfolio resulting from the allocation of capital to the first investment model and the second investment model.

3.3. Regression model

Regression analysis begins with ordinary least squares for both models to determine the nature of the relationship between the two-time series.

$$yt = \beta xt + \varepsilon t \qquad (1)$$

The correlation between the model residuals and the Dickey-Fuller unit root test was analyzed using the ordinary least squares method. The normality test was conducted using the Jarque-Bera test. Additionally, the heteroscedasticity test was performed based on equation (2), which indicates the inverse behavior of the data and suggests that the variables are entirely stochastic.

$$VR(\tau) = \frac{\sum_{t}(\Delta^{\tau} y_t - \overline{\Delta^{\tau} y})^2}{\tau \sum_{t}(\Delta y_t - \overline{\Delta y})^2}. \qquad (2)$$

Where T is the long-run stock variance length, y_t is time series levels, and Δy_t is the daily variation in time series.

3.3.1 First model: the Kalman filter algorithm

The Kalman filter approach involves a set of mathematical equations that solve state and measurement equations simultaneously to obtain unobserved states. This method optimally estimates the values of the unobserved variables using information from the observed variables after minimizing the error. The Kalman filter is a recursive method for computing optimal estimations of the unobserved state vector based on the appropriate dataset. This method is applied to the state space model, and its algorithm provides a recursive solution to optimize the system described in the state space. This solution uses existing data to optimize previous data. The Kalman filter is a method in which models are directly corrected using mathematical models rather than saving all previous data to obtain subsequent data and correct the model. Mathematically, the state space equations in the

Kalman filter process are presented as follows for estimating X ∈ Rn state variables:

(Kalman filter algorithm input: price data, variance model, variance observations, and vector return output).

Algorithm 1: The Kalman Filter model

Algorithm 1 KALAMN FILTER Function: Input: price data, W = model variance, V=observation variance. Output: $\theta_{t|t.}$

Function KALMAN FILTER (Z_t)
If t = then
Initialize $\theta_{0|0} \leftarrow z_0$
Initialize $P_{0|0} \leftarrow 1$
End if
$\theta_{0|0-1} \leftarrow \hat{\theta}_{t-1|t-1}$.
$P_{t|t-1} \leftarrow P_{t-1|t} + W_t$.
$y_t \leftarrow \theta_{t|t} - \hat{\theta}_{t|t-1}$.
$S_t \leftarrow P_{t|t-1} + V_t$.
$K_t \leftarrow P_{t|t-1} S_t^{-1}$.
$\hat{\theta}_{t|t.} \leftarrow \hat{\theta}_{t|t-1} + K_t r_t$.
$P_{t|t} \leftarrow (I - k_t H_t) P_{t|t-1}$
Store $\theta_{t|t.}$ and $P_{t|t}$
Return $\theta_{t|t.}$
End Function

Where $Z_t \in R^m$ represents the observation vector, H_t is the observation matrix, A_t is the system matrix That predicts our position in the next step, where Vt and Wt are observations and covariance matrix values of size (p*p) and (m*m), respectively. Finally, in the above algorithm, the kt coefficient is the Kalman coefficient, which must be chosen so that the error covariance is minimized, and the measurement is reliable.

The Kalman filter algorithm is a simple, scalable model where there is only one stock price variable. Given that the closing stock price (today's closing price at time t) is the best estimator for tomorrow's price (at time t + 1), the state model variable is a single set whose variance is estimated using monthly data at 72 points for each company. This model is based on the moving average (price) of the data. The next step is to use Algorithm 2. After updating the moving price average, it is checked whether the future trade's price is higher than the average or not. If the price is above the average, we will check if we have previously opened a position. If not, future (long) and open trades are purchased, and the portfolio is updated. If the price is below the moving average and there is no open position, a new position is opened by selling (short) and updating the portfolio.

3.3.2 Second model: momentum algorithm

After identifying the stocks, the initial statistical regression tests (normality, stationarity, non-linearity, autocorrelation, etc.) are run. These tests serve as an early indicator of the stability of relationships. Regression analysis reveals a relationship between the two time series. The regression residual indicates that the relationship can potentially be reversed. The Run's experiment provides an estimate of the time it takes for the residue to return and establish a correlation in the residue. VRT is also utilized to analyze the average return on dispersion, indicating the range on which the model can focus. Most importantly, VRP can be used to explore the return reversal on domains, the ultimate success threshold for an expansion that should be included in the portfolio.

Tests play a crucial role in identifying key features in data, models, and interval sizes. Model building and calibration are iterative processes as the optimal interval must be determined to maximize profits in transactions and portfolios, requiring identification of the average reversal rate and standard deviation

measurement for the best returns.

After conducting initial tests using the Kalman filter algorithm and its output, the momentum algorithm is applied with daily future price inputs until a suitable portfolio utilizing the momentum pattern is achieved. The method by Jagadish and Titman (1993) is employed to execute and select the appropriate portfolio based on the Sharp Ratio criterion. Each company's stock is ranked monthly based on risk-adjusted criteria, and the average cumulative return on the portfolio is calculated to select the suitable portfolio using the momentum strategy. Stocks of companies are then chosen based on the Kalman filter pattern in terms of trading position. Finally, the appropriate portfolio model is developed based on the Kalman filter model, incorporating moving average, size, current price, cumulative return, and the company's stock position in the portfolio.

Algorithm 2: The momentum model

Algorithm 2 Momentum: Input x: Log of index futures, Output: Momentum model portfolio.

# READ daily futures prices as $x_{(n,t)}$, where t is the time stamp, n is the number of futures markets, and x ∈ R.
# rebalance () is a function that takes the current portfolio, computes the mean investment in the futures market, and buys and sells so that capital is equally divided among the futures markets.
# w=moving average window size
# IIt=($II_{(1,t)}$, $II_{(2,t)}$, … , $III_{(n,t)}$, where $II_{(i,t)}$=<$C_{(i,t)}$,$P_{(i,t)}$>
# $C_{(i,t)}$ is capital invested in futures contract I at time t
# P_t=($II_{(1,t)}$, $II_{(2,t)}$, … , $III_{(n,t)}$) position in portfolio.
# $P_{(i,t)} \in \{Buy. Sell\}$ position of futures I at time t.
# KALMAN FILTER is the Kalman is the Kalman Filter Function as described in Algorithm 1.
For I = 1 to n do
$C_{(I,0)}$ ← investment / n
$P_{(I,0)}$ ← Buy
End for
For t = 1 to T do
Ct ← rebalance (C_{t-1})
P_t ← P_t-1
For I = 1 to n do
$X_{(i,t)}$ ← get current price
$y_{(i.t)}$ ← KALMAN FILTER(x(i,t) # kalman filter prediction
$z_{(i,t)}$ ← moving average ($y_{(i,t)}$) $\frac{1}{w}\sum_{t-w} hy_{(i.t)}$
if $x_{(i,t)}$>$z_{(i,t)}$ then
if $P_{(i,t)}$!=Buy then
$P_{(i,t)}$ ← Buy
End if
Else
If $P_{(i,t)}$= != Sell them
$P_{(i,t)}$ ← sell
End if
End if
End if
End for

3.3.3 Third model: long-term strategy algorithm

In the long-term equity strategy, stocks are simply purchased. This means that stocks that are falling behind their peers in terms of moving average returns (according to financial theory, corporate stocks move in line with positive news in the group) are identified and purchased. The long-term stock strategy model is a stable model in which capital allocation is done equally, assuming that the beginning and end prices are obtained, and all trades are adjusted at the time of trading. In the first step, the stocks are arranged with their returns in descending order, and then the number of stocks is divided into two halves based on returns.

The top half consists of stocks with better performance than the bottom half. The stocks to be purchased are first determined, and the stocks in the upper half are purchased. Then, the stocks in the lower half are purchased. After that, the portfolio model is updated to allocate to all transactions in the next step. Specifically, stocks with the worst performance are purchased with the expectation that they will acquire other stocks with better performance.

Algorithm 3: Long-term strategy model

Algorithm 3 Long Only: Input E: Stock returns, Output: Long Only portfolio.

# READ stock returns prices as$\varepsilon_{(n.t)}$, where t is the time stamp, n is the number of stocks, and $\varepsilon_{(n.t)} \in R$
# rebalance() is a function that takes the current portfolio, computes the mean investment in the futures market, and buys and sells so that capital is equally divided among futures markets.
# IIt=($II_{(1,t)}$, $II_{(2,t)}$, … , $III_{(n,t)}$), where $II_{(i,t)}$=<$C_{(i,t)}$,$P_{(i,t)}$>
# $C_{(i,t)}$ is capital invested in futures contract i at time t.
# C(t) is the capital value of the portfolio at t.
# P_t=($II_{(1,t)}$, $II_{(2,t)}$, … , $III_{(n,t)}$) position in portfolio.
# $P_{(i,t)} \in \{Buy. Sell\}$ position of futures I at time t.
# Let S be a set of sectors.
# Let s is a sector C S.
# Let ε be a set of equities iu sector S.
# Let e be single equity.
# Let £ be a set of laggard stocks in a sector.
# laggard() is a function that returns [$|\varepsilon|/2$], the worst-performing stocks a.t current time.
for i = 1 to n do
$C_{(I,0)} \leftarrow$ investment/n
end for
for t = 1 to T do
$C_{(t)} \leftarrow$ rebalance ($C_{(t-1)}$)
for s ∈ S do
$£_{(s,t)} \leftarrow$ laggard ($\varepsilon_{(s.t)}$)
For e ∈ ε_s do
Of $P_{(e,t)}$ = Own and e ∉ $£_{(s,t)}$ then
Sell $_{(e)}$
End if
End for
For e ∈ £s do
If $p_{(e,t)}$=Not-own then
Buy $_{(e)}$
End if
End for
End for
End for

3.3.4 Performance Curve Function

The performance curve function, as shown in Algorithm 7, represents the performance of every QIM based on an initial investment of 100 units using this formula

$PC_{(t-1,m)}$ * (1+($QIM_{(t,m)}$).

Here QIM represents the return on the model and PC represents the price. We will use the performance curve function in four models. Kelly with Kalman Filter, Median Kelly with Kalman Filter, Kelly with Moving Average, and Median Kelly with Moving Average.

Fourth model: Kalman Filter Function

The function attempts to forecast whether the QIM return in the next period is positive or negative.

The input to this model is the monthly performance of the QIMs. The function checks whether the forecast for (i+1) is positive or negative when compared to the previous time step. When the Kalman Filter forecast is negative, the signal is converted to 0 and when the forecast is positive the signal is 1. The reason we changed the forecast to binary data is to adjust the Kelly in the upcoming metamodels

Algorithm 4 PERFORMANCE CURVE Function: Input = QIM Returns, output Price, Performance curve of QIM.

READ QIM returns as $X_{(n,t)}$, where t is the time stamp and n is the number of QIM models.
$price_{(i,t)}$ is the value of the model indexed to 100

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{tn} \\ X_{21} & X_{22} & \dots & X_{tn} \\ \dots & \dots & \dots & \dots \\ X_{T1} & X_{T2} & \dots & X_{tn} \end{bmatrix}$$

$Price_{(1:n,0)} \leftarrow 100$
For t = 1 to T do
For I = 1 to T do
$Price_{(i,t)} \leftarrow price_{(I,t-1)} \times (1+x_{(i,t)})$
End for
End for
Return price

five models: Smart model

Now that the returns from the algorithms of quantitative investment models are calculated monthly, they are used in smart models to allocate capital. Therefore, the allocation of capital in the smart model is changed on a monthly basis. In this section, the smart model algorithm is designed to allocate capital to quantitative investment models using the Kalman filter algorithm and Kelly's functions. The optimal amount of capital will be allocated to quantitative investment models. Then, based on Kelly's criterion, the goal is to maximize the Sharpe ratio.

3.3.5 Kelly's criterion algorithm

Kelly's criterion has many desirable characteristics. First, it maximizes shareholder wealth without the risk of bankruptcy, and it maximizes the geometric mean, also known as the combined rate of return on investment. The rate of return is compounded, meaning it comes from returning capital from the previous period and remaining in an investment that can generate self-returns. Second, since Kelly is about reinvestment or a multi-period approach, an investor needs to maximize the geometric mean. Third, the estimated time to achieve the desired wealth is minimal with Kelly. Fourth, Kelly's strategy is shortsighted, meaning that only current investment opportunities and funds should be considered, not future conditions. Finally, Kelly's model allows investors to easily adjust their desired risk at lower expected return costs (McLean et al., 2011).

Since Kelly aims to maximize the wealth logarithm, optimal weights are calculated using equation (3):

$$max \sum_{t-1}^{T} log\left(\sum_{t-1}^{n} 1 + \left(w_{t(t)} r_{t(t)}\right)\right) \qquad (3)$$

Where r_i refers to the return on quantitative investment models and w_i is the maximum weight of the logarithm of wealth that weights are used to calculate portfolio returns at a future time (t + 1).

Algorithm 5: Kelly's functions algorithm

Algorithm 4 Fractional Kelly: Input = QIM returns, output = Portfolio returns.

READ QIM returns as $X_{(n,t)}$, where t is the time stamp and n is the number of QIM models.
$P_{(t)}$ s the value of the portfolio at l.
$II_{(t)}$ is portfolio at current time, , where $II_{(t)} = <C_{(t)}, X_{(t)}>$/
$W_{(t)}$ are the weights to allocate capital to the QIMs.
$C_{(t)}$ iuvestrneut capital.
KELLY() is a fnnction described in Algorithm 5 that calcnlatc fractional Kelly weights for all the QIMs at t.
reallocate() is a function that changes the proportion of capital invested in different QIMs according to their weights, $<II_{(t)}, w_{(t)}>$.

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{tn} \\ X_{21} & X_{22} & \dots & X_{tn} \\ \dots & \dots & \dots & \dots \\ X_{T1} & X_{T2} & \dots & X_{tn} \end{bmatrix}$$

$W_{(0)} \leftarrow 0$
$P_{(0)} \leftarrow 0$
$for\ t\ =\ 1\ to\ T\ do$
$w_{(t)} \leftarrow KELLY\ (x_{(t)})$
$c_{(t)} \leftarrow reallocate\ (II_{(t-1)}, w_{(t)})$
$p_{(t)} \leftarrow \sum_{i=1}^{n} x_{(i)} c_{(t)}$
end for

3.3.6 New smart model

In Kelly's criterion mean model, mean data is utilized. In the mean distribution algorithm, similar to the mean case, there is an alternative method to assess the central tendency of the distribution. However, when the data is not normally distributed, the mean distribution may not always be the best estimate of central tendency. Previous research on earnings forecasts has indicated that the mean can be a superior estimate in terms of performance. On the other hand, Kelly's criterion is a non-distributed approach and is inherently short-sighted. The objective of this algorithm is to demonstrate that the mean can outperform the Sharpe ratio and more accurately represent the central tendency distribution. This algorithm will function similarly to Kelly's model, with the exception that Kelly's criterion calculations will be based on the mean data while keeping other parameters constant. Portfolio returns are also computed based on the weighted returns of the quantitative investment models.

$$f^* = \frac{x-r}{\delta^2} \qquad (4)$$

One of the major challenges in smart models is changing data regimes. If the pattern or structure has been paused for some time, a change in the data regime can lead to the loss of quantitative investment models. Potentially, to restart investment, a prudent portfolio manager wants to avoid a loss situation by allocating assets and also prefers a situation in which capital in particular will avoid losses. Preventing loss-bearing investments can improve Sharp returns and ratios. Kalman filter is used to prevent losses in investment in quantitative-specific investment models and focus on investments with potentially positive returns. The Kalman filter is also used to evaluate whether models have positive or negative returns in t + 1. The Kalman filter helps avoid negative forecast return periods, but invest using the forecast for positive returns. Kelly's criteria and Kalman filter functions were used to construct this model. At each stage, the Kalman filter predicts whether the quantitative investment models will have a negative or positive return. Quantitative investment models will be calculated as 1 for positive predictions and 0 for negative predictions. The quantitative investment model is eliminated by the negative predictions, and Kelly's criterion weight return will be recalculated using the number of quantitative investment models.

Algorithm 6: Kelly's mean algorithm

Algorithm 5 Median Kelly: Input = QIM returns, Output = Portfolio returns.

READ QIM returns as $X_{(n,t)}$, where t is the time stamp and n is the number of QIM models.
$P_{(t)}$ s the value of the portfolio at l.
$W_{(t)}$ are the weights to allocate capital to the QIMs.
$C_{(t)}$ iuvestrneut capital.
$II_{(t)}$ is portfolio at current time, , where $II_{(t)} = <C_{(t)}, X_{(t)}>$
MEDIAN KELLY () is a function described in Algorithm 6, it calculates Median Kelly weights for all the QIMs at t.
reallocate () is a function that changes the proportion of capital invested in different QIMs according to their weights, $<II_{(t)}, w_{(t)}>$.

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{tn} \\ X_{21} & X_{22} & \dots & X_{tn} \\ \dots & \dots & \dots & \dots \\ X_{T1} & X_{T2} & \dots & X_{tn} \end{bmatrix}$$

$W_{(0)} \leftarrow 0$
$P_{(0)} \leftarrow 0$
$for\ t\ =\ 1\ to\ T\ do$
$w_{(t)} \leftarrow\ MEDIAN\ KELLY\ (x_{(t)})$
$c_{(t)}\ \leftarrow\ reallocate\ (II_{(t-1)}.w_{(t)})$
$p_{(t)} \leftarrow \sum_{i=1}^{n} x_{(i)} c_{(t)}$
end for

Algorithm 7: Kelly's Criterion Algorithm with Kalman filter

Algorithm 6 Kelly uith Kaalan Filter: Input = QIM returns. Output = Portfolio returns.

READ QIM returns as $X_{(n,t)}$, where t is the time stamp and n is the number of QIM models.
$P_{(t)}$ s the value of the portfolio at l.
$W_{(t)}$ are the weights to allocate capital to the QIMs.
$C_{(t)}$ iuvestrneut capital.
$II_{(t)}$ is portfolio at current time, , where $II_{(t)} = <C_{(t)}, X_{(t)}>$
reallocate () is a function that changes the proportion of capital invested in different QIMs according to their weights, $<II_{(t)}, w_{(t)}>$.
PERFORMANCE CURVE() is the function described in Algorithm 7. It con-verts QIM returns to price.
KELLY() is a function described in Algorithm 5 it calculates fractional Kelly weights
BIN ARY KALMAN FI LT ER() is a function described in Algorithm 8. It gives a binary output based, on the forecast from our Kalman Filter.

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{tn} \\ X_{21} & X_{22} & \dots & X_{tn} \\ \dots & \dots & \dots & \dots \\ X_{T1} & X_{T2} & \dots & X_{tn} \end{bmatrix}$$

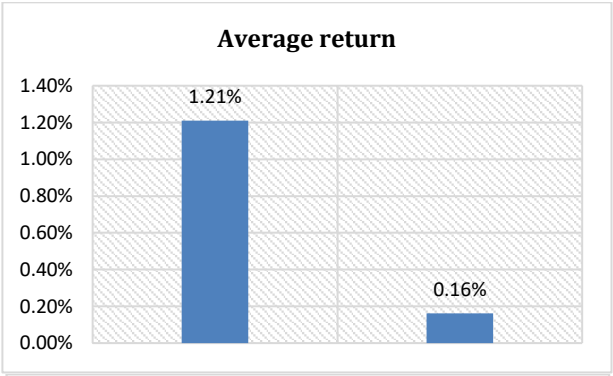
for t = 1 to T do
$Kell_{y(t)}$ = KELLY($x_{(t)}$)
Sum ← 0
for i = 1 to n do
$price_{(t,i)}$ ← PERFORMANCE CU RV E($X_{(t,i)}$)
if BINARY KALMAN FILTER($price_{(t,i)}$) 1 = 1 then
$Kelly_{(t,i)}$ = 0
end if
sum += $Kellv_{(t,i)}$
for i = 1 to n do
$Kelly_{(t,i)} = \frac{kelly_{(t.i)}}{sum}$
End for
End for
$W_{(t)}$ ← Kelly (t)
$C_{(t)}$ ← reallocate $(II_{(t-1)}.w_{(t)})$
$P_{(t)} \leftarrow \sum_{i=1}^{n} x_{(i)} c_{(t)}$
End for

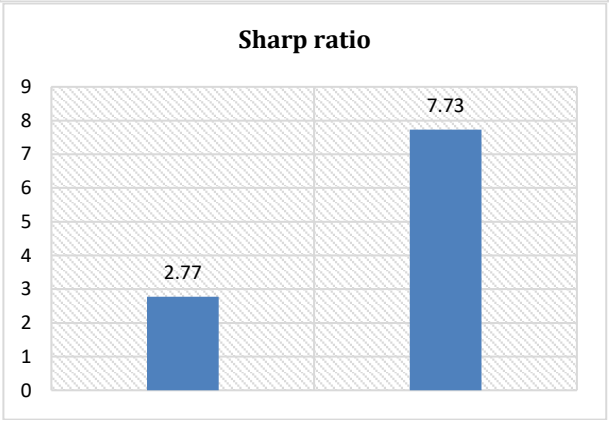
2 4. Results of model parameters and functions

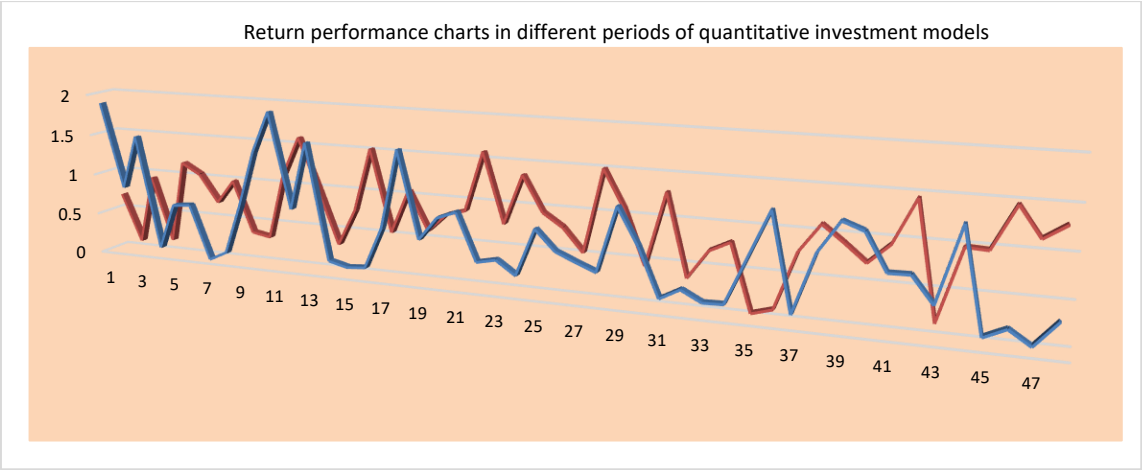
To create intelligent financial portfolios considering the parameters of companies operating in various industries on the Tehran Stock Exchange from March 2017 to March 2021, 18 companies were chosen for portfolio selection utilizing the Kalman filter algorithm, the momentum algorithm, a long-term strategy, and ultimately, a smart model based on Kelly's functions, Kelly's mean, and Kelly's criterion with the Kalman filter. The proposed algorithms were initially executed in Matlab software, and subsequently, the average return, average volatility, and Sharpe ratio were calculated and derived for quantitative investment models (momentum and long-term investment). The findings revealed that the mean returns and volatility in the long-term stock strategy exceeded those of the momentum model, contrary to the expected lower volatility in the long-term stock strategy. Additionally, the Sharpe ratio was negative in both models, indicating a negative return. The results of the algorithm performance are detailed in Table 1.

Table 1: Quantitative Investment Models' Performance

Description	Momentum	Long-term strategy
Average return	0.1624 %	1.21 %
Average fluctuations	0.01336 %	3.14 %
Sharp average ratio	7.73	2.77



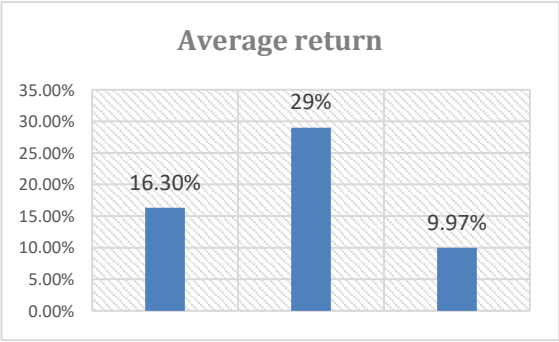


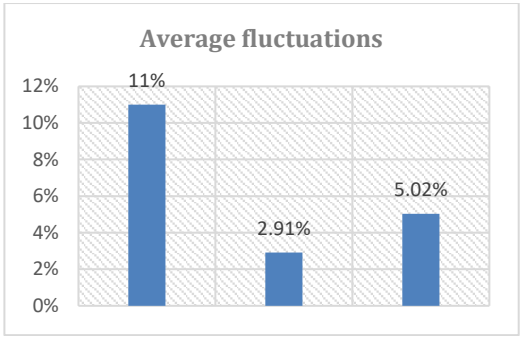


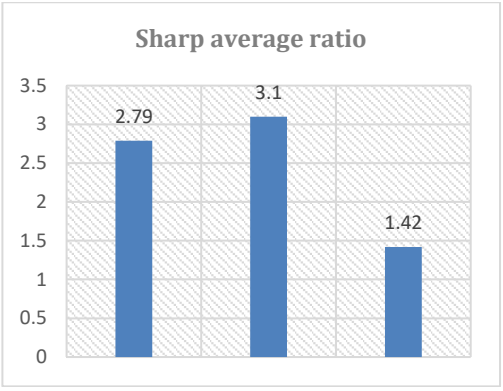
After implementing quantitative investment models, it is now time to focus on smart investment models that allocate capital to these quantitative investment models. The results of the smart model showed higher returns compared to the quantitative investment models, with the best Sharpe ratio and performance seen in the smart Kelly model. Analysing the Sharpe ratio in each application was very promising for the proposed smart model and framework, as the smart model demonstrated the highest efficiency and therefore the best Sharpe ratio. As shown in Table 2, the average return in Kelly's criterion is higher than all other models, indicating that this smart algorithm provides a good measure of investment and return based on Sharpe ratios and average volatility.

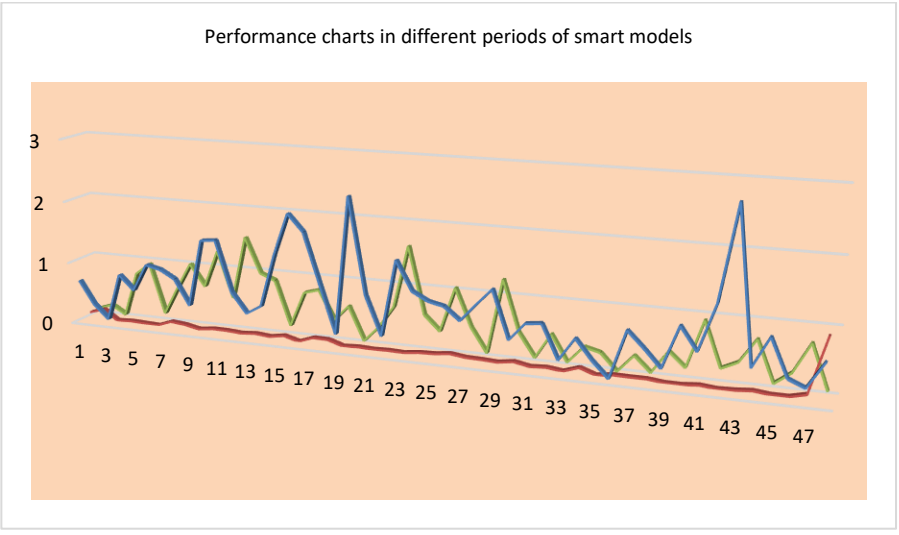
Table 2: Smart Models' Performance

Description	Kelly functions	Average Kelly functions	Kelly criteria with the Kalman filter
Average return	9.97 %	0.29 %	16.30 %
Average fluctuations	5.024 %	2.91 %	11 %
Sharp average ratio	1.42	3.1	2.79




Average fluctuations
12%
10%
8%
6%
4%
2%
0%
11%
2.91%
5.02%


Sharp average ratio
3.5
3
2.5
2
1.5
1
0.5
0
2.79
3.1
1.42


Performance charts in different periods of smart models
3
2
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47

Based on the optimal values obtained, it is evident that Kelly's criterion algorithm demonstrated superior performance, higher efficiency compared to other models, and better Sharpe ratios. Additionally, a key strength of this model is its lower volatility in comparison to previous models, showcasing the stability of the algorithm. In conclusion, smart models that offer increased returns and lower risk are the most effective and efficient models available.

5. Discussion and Conclusion

This research aimed to propose a metaheuristic model for creating a smart financial portfolio on the Tehran Stock Exchange. The model utilized the Kalman filter and Kelly's function to form an optimal portfolio. To design the optimal and smart portfolio model, quantitative investment models were first used, including the momentum algorithm and the long-run investment algorithm. These models utilized technical indicators and fundamental ratios to select the optimal portfolio. Additionally, Kelly's function, Kelly's mean, Kelly's composition algorithms, and the Kalman filter were incorporated into the smart model.

Key parameters such as average returns, mean volatilities, and average Sharpe ratio were compared across the four different models over a 5-year period from 2019 to 2023. Data was extracted monthly and organized using Excel software. The years were categorized as periods of decline, equilibrium, and growth. Before designing the model, regression assumptions were analysed, including normality of the data, stationary state, non-heteroscedasticity, and non-linearity between the data.

The results indicated that the data was normal based on the Jarque-Bera test with an error level of less than 5%. Stationarity analysis was conducted using the Dickey-Fuller test, showing that all variables and parameters were stationary at a 99% confidence level. Additional statistical tests confirmed the efficiency and Sharpe ratio of the proposed smart Kelly algorithms outperformed other models. The average return, Sharpe ratio, and volatility in Kelly's criterion model were superior to all other models.

Ultimately, the Kelly criterion model demonstrated better performance than quantitative investment model algorithms. The value of the portfolio derived from the proposed Kelly algorithm exceeded that of other algorithms, highlighting the efficiency of the proposed algorithm and model. The results suggest that the smart Kelly models were more effective in selecting portfolio models. This demonstrates the efficacy of the proposed algorithm and model.

The performance of portfolios formed using the proposed algorithms consistently showed that the average return in Kelly's algorithm surpassed that of the momentum and long-run investment algorithms. These findings align with the results of Saran Mehran et al. (2016).

Researchers interested in conducting research in relevant areas are recommended to explore the following topics:

- Utilize various quantitative investment algorithms, including pair shares and market indexes.
- Develop objective functions that consider additional risk and performance metrics of the portfolio, and compare outcomes.
- Examine the impact of integrating other fundamental ratios and technical indicators into the algorithm structure.
- Assess the effects of different factors and investment styles, such as liquidity, trading volume, etc., on the model input.
- Investigate macroeconomic factors that influence capital asset price fluctuations.
- Conduct market segmentation by industry and conduct comparisons between different sectors.
- Utilize a larger statistical sample, among other suggestions.

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Examining the Relationship Between Audit Quality and Risk Taking in Value Creation: The Role of Company Size as a Mediator

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Abstract

Objectives: The present study aims to investigate the relationship between audit quality and risk-taking behavior in firms, focusing on the mediating role of company size in value creation.

Design/methodology/approach: This research is applied and employs a causal correlation methodology. The statistical population consists of all firms listed on the Tehran Stock Exchange. A systematic sampling method was utilized to select 140 firms as the study sample, covering a period of 7 years from 2017 to 2022.

Findings: The hypotheses were tested using simple and multiple linear regression analyses after verifying classical assumptions and applying the Chow test due to the mixed nature of the research data. The results indicate that both audit quality and risk-taking have a positive and significant effect on value creation. Additionally, company size plays a crucial mediating role in the relationship between audit quality, risk-taking, and value creation.

Innovation: This ongoing research provides compelling evidence that effective political communication can mitigate the risk of lawsuits against auditors, thereby enhancing audit quality. These findings underscore the importance of integrating governance practices that foster transparency and accountability in financial reporting.

Keywords: Audit quality, Risk-taking, Firm Value, Firm size.

1. Introduction

In general, risk and return are the most important investment concepts that are always associated with investment decisions and are considered the basis of decision-making. Risk-taking can be defined as "engaging in any activity that has at least a vague and uncertain outcome" (Ostadi and Tadrisipour, 2018). By reducing information asymmetry and agency conflict between users and providers of financial statements, auditing corrects the destructive effects of the separation of ownership and management. Therefore, audit quality is a tool to reduce information risk for users of financial statements. Such a reduction in information risk can create value for stakeholders, as it provides users with reasonable assurance about any significant deviations and frauds (Furiady and Ratnawati, 2015). It can be said that the lack of awareness of economic factors, including stock exchange investors, the impact of audit quality, and risk acceptance in creating the value of a business unit and ignoring it can be effective in reducing investment. This can prevent the further development of securities. On the other hand, creating value and increasing shareholders' wealth in the long term is one of the most prominent goals of companies and capital market participants, and this can only be achieved through optimal performance. Underestimating audit quality and risk-taking in creating value in business units of underdeveloped countries with traditional market structures and inefficient capital markets is very important and leads to more appropriate returns. Value creation almost depends on the amount obtained by the end user (buyer) who is focused on creating value, be it an individual, an organization, or a society, and such a desire leads to the exchange of valuable currency obtained. We can mention two main conditions that are critical for success in value-creation activities. First, the amount of currency exchanged must be greater than the producer's costs (currency, time, effort, etc.). Second, the amount of money the buyer paid for the service. These two functional conditions represent what differentiates newly created value from buyers' goals (Sri and Selimun, 2019). In general, without such differences, buyers and value creators seek to repeat such activities in the long run. Based on this, considering the increasing importance of audit quality and risk-taking in a business unit, the topic of the upcoming research is the relationship between audit quality and risk-taking to create value with the mediating role of company size. In the continuation of the structure of the research, firstly, the development of the theoretical foundations, hypotheses, and experimental foundations of the research are presented, followed by the methodology and operational definitions of the research variables and finally, the findings and conclusions of the research are presented.

Theoretical, empirical, and research hypotheses

The securities exchange is the most important way of equipping and allocating capital in the country, and knowledge of this market and its elements and relationships is one of the important factors in the development of the capital market. Investors are one of the most important elements of this market. Investors have different goals when investing in the shares of companies. They try to push their resources to the most profitable for them, and if their investment does not lead to the desired profit, they will exit the stock market and invest in other activities (Jahanshad and Shabani, 2015). In this regard, awareness of the level of risk for companies can also play a significant role in decision-making. In financial literature, risk is defined as the probability of a difference between actual returns and expected returns and is divided into two categories. The first category includes risks that relate to internal factors such as management risk, liquidity risk, inability to pay debt, etc., which is called unsystematic (reducible) risk. The second category includes risks that are not specific to one or more firms but are related to general market conditions such as economic ,political,social ,and other conditions and are uncontrollable and irreducible under the name of systematic risk (β) ,hence it can play a significant role in decision-making by

managers of companies and investors. One of the important factors in companies is the corporate governance structure of these companies, which has a significant impact on the decisions of the organization and its financial statements (Poor Ahmadi et al., 2021).

Profit is one of the most important items in financial statements that is considered by firms as one of the criteria for evaluating performance and determining the value of the firm. The purpose of earnings reporting is to provide useful information for measuring management efficiency, predicting the future of the for-profit unit, and the future distribution of dividends. It is also a basis for tax diagnosis, price analysis of products, etc. It is for beneficiaries. A lot of research has been done on profit. Many of these studies have examined the impact of different factors on the profitability of companies. In reviewing the performance of companies, it is important to pay attention to internal and external factors that affect their profitability (Ebrahimi Kordelar and Javani Ghalandari, 2016). Corporate risk and audit quality are factors that can play an important role in the value of the company. Risk is the probability that a particular action or action (or inaction) will result in undesirable or unintended losses or outcomes. Almost all human endeavors involve some degree of risk, but some of them carry more risks. In financial literature, risk can be defined as unexpected events, usually changes in the value of assets. Or debts, he said. Firms are exposed to different types of risk, and therefore, risk is inevitable for the company. Auditing is the duty of evaluation to be created by the management of the economic units to investigate the internal control system and to ensure the adequacy of the control system of the company in terms of correct, appropriate, economical, effective, and efficient use of resources, test, evaluation, and reporting (Sayadi et al., 2019). Expansion and increasing complexity of economic units in the world have advanced. Today, the needs resulting from the lack of resources and increased competition, the existence of a variety of risks in the financial, administrative, and commercial fields that threaten their organizational goals and objectives, both internally and externally, have made it impossible to direct and individual control of these units and the need to establish an effective system of control as an integral part of an efficient management system, such as auditing. Attention will be given to them. Audit quality is also important for the company's survival. One of the most common definitions of audit quality is the one given by D'Angelo (1981). He defines audit quality as "an evaluation of the market" of the probability that the auditor will (1) discover cases of significant distortions in the financial statements or accounting system of the owner and (2) report significant distortions discovered. The use of this definition to describe the actual quality of an audit is made with the basic assumption that the perception of audit quality reflects the actual quality of the audit. Auditors who specialize in the industry can perform higher-quality audits due to their ability to identify and deal with specific industry problems. In addition, the more experience an audit firm gains in an industry, the more interest it has in providing superior-quality auditing services because of its positive reputation. For example, Benito Arrunanda (2000) showed that auditors with specific industry audit expertise have higher audit quality for two major reasons. First, more familiarity with the accounting and auditing problems of those industries is due to the continued implementation of the second audit and the motivation to gain and maintain reputation in auditing that particular group of industries. According to the mentioned materials, the hypotheses of the present study are presented as follows:

Research Hypotheses

H1: Audit quality has a positive and significant impact on value creation.

H2: Risk-taking has a positive and significant impact on value creation.

Hy3: Company size plays a mediating role in the relationship between audit quality and value creation.

H4: Firm size mediates the relationship between risk-taking and value creation.

Research Background

Dhifi et al. (2024) conducted research titled "The Relationship between Audit Quality and Firm Performance: The Mediating Effect of Integrated Reporting." They stated that decision-makers in any organization require an audit to ensure the reliability of the information presented in reports. This task is performed by a qualified person who meets specific criteria such as experience, competence, and credibility, which are essential for implementing integrated reporting. The aim of this study was to provide empirical evidence of the mediating effect of integrated reporting (IR) on the relationship between audit quality and company performance. The sample included 36 French companies from 2012 to 2021. The data was analyzed using a structural equation model and hypotheses were tested using Stata 17 software. The empirical results showed that IR quality plays a mediating role (complementary mediation) in the relationship between Big4 firms, auditors' competence and experience, and the performance of French companies. However, it negatively mediated the relationship between auditors' experience and performance in a complementary way.

Abu Afifa et al. (2023) stated in their research titled "Mediating Influence of Earnings Management in the Nexus between Audit Quality and Company Value: New Evidence from the Jordanian Market" that audit firm industry specialization positively affects earnings management practices while size and tenure do not. This implies that industry specialization does not restrict earnings management but rather leads to an increase in opportunistic behaviors. Audit firm size and industry specialization positively affect company value, while audit firm tenure does not. Additionally, the findings indicate that earnings management practices negatively affect company value, and earnings management acts as a mediator for the audit quality and company value relationship.

Birjandi et al. (2020) studied the relationship between audit quality and risk-taking on value creation in companies. The purpose of the study was to investigate the impact of audit quality on risk-taking to create corporate value. A sample of 185 companies listed on the Tehran Stock Exchange from 2013 to 2018 was selected. The Multivariate regression method was used to test hypotheses using the panel method. The criteria used to assess audit quality were the auditor's expertise, auditor tenure, audit institution size, ownership concentration, and non-executive board members. The results showed that all components of audit quality and risk factors significantly impacted the company's value. Additionally, all components modified the effect of risk-taking on the company's value creation.

Phan et al. (2020) conducted a study titled "The Impact of Audit Quality on the Performance of Hanoi Stock Market Member Firms." The study investigated the impact of audit quality on the performance of listed companies in the securities trading class of Hanoi, Vietnam. Data from 228 listed companies in the Hanoi securities trading class were analyzed using SPSS 22 and Smart PLS 3.0. The results showed that audit quality positively impacted the financial performance of companies in the Hanoi securities trading class. It also had a positive impact on customer loyalty and employee satisfaction. The study provided recommendations for improving audit quality in Vietnam.

Florackis et al. (2020) examined innovative risk, risk-taking motives, and the relationship between managerial ownership and corporate value. Using parametric and semi-parametric estimation methods, they investigated how managerial ownership affects firm value, considering the trade-off between alignments and risk substitution effects. They found that risk substitution affects the effect of management ownership alignment in companies with severe succession problems, leading to a weak or absent relationship between managerial ownership and company value. By demonstrating that companies exposed to risk substitution demonstrate more

conservative investment and financing policies, they identified an acceptable channel for these effects. They also showed that including stock options in management compensation packages reduces the problem of risk substitution to some extent. The research findings suggested that semi-parametric methods may be useful for future studies focusing on nonlinear properties in the data.

Mohammadi et al. (2020) studied the moderating effect of audit quality and financial analysts on the readability of financial reporting and agency costs in firms listed on the Tehran Stock Exchange. They investigated the moderating effect of audit quality and financial analysts' coverage on the readability of financial reports and agency costs. The sample included 145 firms listed on the Tehran Stock Exchange from 2011 to 2017. The results of dynamic panel estimation showed that companies with better financial report legibility experienced reduced agency costs, and the negative relationship between readability and agency costs was more pronounced in companies with higher audit quality, internal control quality, or analyst coverage. Reading financial reports can help monitor the opportunistic behavior of internal employees, thereby reducing agency costs.

Sri, et al. (2019), wrote an article titled "The Relationship between Audit Quality and Risk-Taking for Value Creation in Indonesia." The purpose of this paper is to assess the impact of audit quality and risk-taking on value creation. This study is based on panel data and the multivariate regression method. The research uses fixed and random effects to estimate regression. In this paper, five components of audit quality, including auditor expertise, tenure, size of the audit firm, ownership concentration, and percentage of limited members of the board of directors, are studied. The results of this study showed that, among the studied variables and risk factors, only tenure and ownership concentration have a significant effect on the value creation of companies. In other words, both ownership concentration and tenure have a positive effect on value creation, while other variables have no significant effect on value creation. Moreover, none of them can affect value risk.

Blandon and Bosch (2017), in a study titled "Audit Partner's Expertise in Industry and Audit Quality," concluded that the lack of industry expertise for the audit partner has a significant impact on audit quality. It seems that considering the relationship between an auditor's expertise and audit quality is an appropriate criterion for empirical studies in this field, and the most deficient aspect in existing studies is emphasizing the importance of organizational structure in the review. The relationship between audit quality and various variables.

Tehranchian et al. (2017), in a study titled "Examining the Role of Audit Quality on Decision-Making of Information Users," concluded that if financial data users have the necessary assurance that an auditor specializing in the relevant industry is in the company, they will identify that unit as an honest and impartial information provider demanding transparency and minimizing the possibility of asymmetric information in their minds. As a result, their investment will be fully aligned with the disclosed information.

Darvishi (2017) examined the impact of audit report quality on the financial performance of companies listed on the Tehran Stock Exchange. The purpose of this study was to investigate the effect of audit report quality on the financial performance of companies listed on the Tehran Stock Exchange. The statistical population of this study is all firms listed on the Tehran Stock Exchange that were active between 2011 and 2015. To determine an appropriate sample size for this study, 125 companies were selected using a systematic exclusion method and applying restrictions. All steps in the Eviews software were performed by a panel regression test. The results showed that the type of auditor's report has an impact on the firm's performance.

Robu and Robu (2015), in a study entitled "The Impact of the Auditor's Report on the Relevance of Accounting Information Reported by Romanian Exchange Firms," concluded that, analytically, based

on four econometric models evaluated, the return supplied by stocks is directly and positively affected by reported accounting results.

Taghizadeh Khanghah (2014), in a study entitled "Investigating the Relationship between Audit Quality and Financial Reporting Quality," concluded that the existence of audit rules and principles, as well as the application of supervision to ensure the proper implementation of existing rules by auditors, improves the quality of the financial statements provided by the Board of Directors. The higher the guarantee of the implementation of these rules, the less likely it is for individuals to attempt to circumvent them.

Ahmadi et al. (2014) studied the effect of audit quality on the future stock returns of companies listed on the Tehran Stock Exchange. Auditing increases the credibility of information available to users, and with an increase in the quality of the audit, the quality of the information also increases. Auditing reduces the information asymmetry between management and users so that users of financial reports can evaluate and predict the financial performance of the company. This research investigates the relationship between audit quality and future stock returns. The statistical sample of this study was the data of 100 firms listed on the Tehran Stock Exchange from 2005 to 2011. Panel analysis was used to test the research hypotheses. The findings of the study indicated that there was a significant positive relationship between the auditor's expertise and the size of the audit institute and future stock returns, and there was a significant negative relationship between the period of the auditor's tenure and future stock returns.

Research Methodology

The present research is applied and, from a methodological perspective, a causal correlation type (post-event). The statistical population included all listed firms on the Tehran Stock Exchange, and the study period was 2017 to 2022. Companies listed on the Tehran Stock Exchange that meet the following criteria have been selected as a sample. To be comparable, the financial year for the firms ends in March. During the 6-year period, the examination period has not changed the financial period. Information about the variables selected in this study is available. They are not banks, insurance companies, or investment firms. Finally, 140 companies were selected as the final sample for the research. Data analysis is done using the mixed data method and panel data approach, using Eviews 12 software and standard error tools to test hypotheses.

Operational Definitions of Research Variables

Regression models of research:

$Roait = \alpha_0 + \alpha 1\ Auditqit + \varepsilon it$

$Roait = \alpha 0 + \alpha 1\ Riskit + \varepsilon it$

$Roait = \alpha 0 + \alpha 1\ Auditqit + \alpha_2\ Sizeit + \varepsilon it$

$Roait = \alpha 0 + \alpha 1\ Risk_{it+\alpha 2}\ Sizeit + \varepsilon it$

Operational definitions of variables:

Dependent variable: ROA: The rate of return on assets (ratio of net profit to assets)

Independent variables: Auditq: The quality of the audit, which is made up of two components: the auditor's tenure and the size of the auditor.

Tenure: The Term Of Auditor

One quantitative indicator of audit quality is the auditor's professional care and ability to supervise, which is influenced by the duration of the auditor's tenure. Therefore, the longer the auditor's tenure, the greater their knowledge of the client and expertise in the specific industry will be, ultimately enhancing the quality of the audit (Myers et al., 2003).

AudSIZE: Auditor Size

The quality of work from audit firms can vary, leading researchers to seek alternatives to distinguish between high-quality and low-quality firms. Factors such as the size, age, and brand of the auditing institutions serve as distinguishing criteria. Larger and more established brands are generally associated with higher quality work than other institutions (D'Angelo, 1981).Risk: Risk-taking: To measure this variable, unsystematic risk is used.

Unsystematic risk refers to the volatility of fluctuations in the prices of eleven individual shares during previous periods, as measured by their standard deviation (Tehran Stock Exchange Organization, 2018).

$$\alpha = \sqrt{\left(\frac{1}{n-1}\right)\sum_{i=0}^{n}(ri - E(r)\text{^}2)}$$

Mediator Variable:

Size: The size of the firm, which is equal to the natural logarithm of the firm's Assets.

Research Findings

Descriptive statistics

Table 1 displays the descriptive statistics of the research variables. It is evident that the average yield of assets is 0.087, indicating that the majority of the data centers around this point. The highest standard deviation is associated with company risk (57.39), while the lowest is linked to auditor experience (1.18). The maximum and minimum values also represent the highest and lowest points in the data set.

It has been observed that all variables are at a static level, and the null hypothesis, which is based on the existence of a single root and non-static variables, is rejected at a 95% confidence level. Therefore, there is no issue of false regression.

The Chow test statistic value is 0.862, which is greater than 0.05. Therefore, the null hypothesis is not rejected. For research models, the pooling model is selected as the preferred model, as the widths of the bases are equal. Consequently, the Hausman test is not necessary.

Table 1: Descriptive statistics variables

Variable	ROA	AUDITS	AUDIT	RISK	SIZE
Mean	0.087119	0.200355	2.129433	48.26416	5.916752
Median	0.091930	0.000000	2.000000	29.92000	5.886384
Max.	0.808576	1.000000	5.000000	470.8800	7.352191
Min.	-0.744335	0.000000	1.000000	0.000000	5.084408
Std.v	0.233619	0.400621	1.185729	57.39583	0.412329

Table 2: Unit root test of Variables

Variable	Test Statistics	Sig
AUDITS	-2.78956	0.0000
AUDITT	-2.04348	0.0000
RISK	-10.7130	0.0000
SIZE	-10.2948	0.0000
ROA	-14.7505	0.0000

Table 3: Result Test F-Limer

Model	Sig
Pooling Model	0.862

Table 4: Test results of research hypotheses

Variables	Coefficients	Statistic t	Sig
$Roa_{it} = \alpha_0 + \alpha_1 Tenure_{it} + \varepsilon_{it}$			
Tenure	27.7323	6.09113	0.0000
C	0.0847	8.8848	0.0000
Coefficient of determination	0.061	F	0.0000
$Roa_{it} = \alpha_0 + \alpha_1 AudSize_{it} + \varepsilon_{it}$			

Variables	Coefficients	Statistic t	Sig
C	0.0835	9.2757	0.0000
AudSize	4.5784	10.4717	0.0000
Coefficient of determination	0.163	F	0.0000
$Roa_{it} = \alpha_0 + \alpha_1 Risk_{it} + \varepsilon_{it}$			
C	0.0816	7.9815	0.0000
Risk	0.0655	3.2354	0.0013
Coefficient of determination	0.021	F	0.0000
$Roa_{it} = \alpha_0 + \alpha_1 Tenure_{it} + \alpha_2 Size_{it} + \varepsilon_{it}$			
Tenure	94.0299	8.3176	0.0000
Size	3.3398	11.4797	0.0000
Coefficient of determination	0.260	F	0.0000
$Roa_{it} = \alpha_0 + \alpha_1 AudSize_{it} + \alpha_2 Size_{it} + \varepsilon_{it}$			
C	0.0738	8.1514	0.0000
AudSize	4.1561	9.9866	0.0000
Size	0.9829	9.2677	0.0000
Coefficient of determination	0.299	F	0.0000
$Roa_{it} = \alpha_0 + \alpha_1 Risk_{it} + \alpha_2 Size_{it} + \varepsilon_{it}$			
C	0.0718	7.1316	0.0000
Risk	0.1974	6.0800	0.0000
Size	2.0978	9.8898	0.0000
Coefficient of determination	0.207	F	0.0000

In the table above, the impact of the auditor's tenure on return on assets was investigated. The regression model test results, as described in the table, show that the absolute value of the t statistic for the auditor's tenure variable is greater than 2, indicating a significant relationship between this variable and value creation. Therefore, the null hypothesis is rejected, and audit quality (as indicated by auditor tenure) has a positive and significant effect on value creation. The P-value for the F-statistic (prob (F-statistic)) is 0.000, indicating the model's significance at a 95% confidence level. Additionally, Watson's camera statistic falls between 1.5 and 2.5, showing no autocorrelation between the model's residuals.

Similarly, in the table above, the impact of the auditor's rotation period on return on assets was examined. The results show that the absolute value of the t statistic for the auditor's size variable is greater than 2, indicating a significant relationship between this variable and value creation. Consequently, the null hypothesis is rejected, and audit quality (based on auditor size) has a positive and significant effect on value creation. The P-value for the F-statistic is 0.000, confirming the model's significance at a 95% confidence level. Watson's camera statistic also falls between 1.5 and 2.5, indicating no autocorrelation in the model's residuals.

Furthermore, the table above explores the effect of risk-taking on value creation. The results show that the absolute value of the t statistic for the risk variable is greater than 2, demonstrating a significant relationship between this variable and value creation. Therefore, the null hypothesis is rejected, and risk-taking has a positive and significant effect on value creation. The P-value for the F-statistic is 0.001, indicating the model's significance at a 95% confidence level. Watson's camera statistic remains between 1.5 and 2.5, indicating no autocorrelation in the model's residuals.

In the table above, the mediating effect of firm size on the relationship between auditor tenure and return on assets was investigated. The results show that the absolute value of the t statistic for both the auditor's tenure variable and company size is greater than 2, with a significant relationship observed between these variables and value creation. The coefficient of determination increased to 0.26 compared to 0.06 without the mediator variable, indicating that company size plays a mediating role in the relationship between auditor tenure and value creation. The model's significance at a 95% confidence level is confirmed by a P-value of 0.000 for the F-statistic, and Watson's camera statistic shows no autocorrelation in the model's residuals.

Similarly, in the table above, the mediating effect of firm size on the relationship between auditor size and return on assets was examined. The results show a significant relationship between the auditor size variable, company size, and value creation. The coefficient of determination increased to 0.29 compared to 0.16 without the mediator variable, indicating that company size mediates the relationship between auditor size and value creation. The model's significance at a 95% confidence level is confirmed by a P-value of 0.000 for the F-statistic, and Watson's camera statistic shows no autocorrelation in the model's residuals.

Overall, the results suggest strong relationships between auditor tenure, auditor size, risk-taking, company size, and value creation, with significant mediating effects of company size in the relationships between auditor tenure and auditor size with value creation.

Therefore, the null hypothesis was rejected, and it can be concluded that company size plays a mediating role in the relationship between risk-taking and value creation. The P-value associated with the F-statistic (prob (F-statistic)), which signifies the overall significance of the regression, is 0.000, indicating that the model is significant at a 95% confidence level. Additionally, the Durbin-Watson statistic falls between 1.5 and 2.5, suggesting no autocorrelation among the residuals of the model.

Discussion and Conclusion

The purpose of this study is to investigate the relationship between audit quality and risk-taking in order to create value, with company size playing a mediating role. The results of the regression model test related to the first hypothesis and the independent variable of auditor tenure showed that the absolute value of the t-statistic for the auditor's tenure period variable is greater than 2. A significant relationship was observed between this variable and value creation, leading to the rejection of the null hypothesis. The quality of the audit, from the perspective of auditor tenure, had a positive impact on creating value.

When investigating the first hypothesis with the independent variable of auditor size, it was found that the absolute value of the t-statistic for the auditor size variable was also greater than 2. A significant relationship was observed between this variable and value creation, leading to the rejection of the null hypothesis. The quality of the audit, based on the size of the auditor, had a positive and significant effect on value creation.

Many experts argue that audit quality improves as the auditor's tenure increases, as the auditor becomes more familiar with the business owner's activities and reporting issues, thus gaining more experience. Most studies have found a positive relationship between audit quality and auditor tenure. The size of an audit firm is also a factor that influences audit quality. Larger audit firms provide higher-quality auditing services to enhance their reputation in the market. These firms strive to deliver high-quality work by investing in resources and training for their auditors. Larger companies benefit from auditors working in larger audit firms, as evidenced by various studies in the accounting literature linking audit quality to financial performance.

In the second hypothesis, the effect of risk-taking on value creation was explored. The results of the regression model test showed a significant relationship

between risk-taking and value creation, with risk-taking having a positive and significant effect on value creation. This theory suggests that increased risk-taking can lead to higher profits and benefits, supported by various studies. Risk is a key component of decision-making, involving uncertainty in specific areas. Organizations that take risks and adapt to changes and conditions tend to have better revenue and operations.

The third hypothesis, examining the auditor's tenure and company size as independent variables, revealed a significant relationship between these variables and value creation. The size of the organization plays a mediating role in the relationship between audit quality and performance, with higher audit quality in larger organizations leading to performance improvements.

In the fourth hypothesis, the mediating effect of company size on the relationship between risk-taking and value creation was investigated. The results showed a significant relationship between risk, company size, and value creation, with company size strengthening the impact of risk on performance. Larger organizations experienced higher performance with greater risk-taking, indicating a positive correlation between risk and performance.

Limitations of research

Researchers are constantly confronted with limitations in their research, some of which become apparent right from the start. One of the fundamental aspects of research is having access to statistics and information. However, there are various challenges that hinder access to research resources such as books, journals, statistics, databases, and more. This is particularly difficult in our country. Additionally, one of the major challenges in conducting research is accurately determining the quantity of variables involved, including the quality of audits.

Suggestions derived from research findings

According to the results of this study, the following suggestions are made for utilizing these findings:

- **The analysis of**
  - the first hypothesis revealed that audit quality has a positive and significant impact on value creation. Therefore, it is recommended that:
  - Managers aim to enhance company performance by engaging auditors with a track record of prior involvement with the company.
  - Managers should consider hiring audito
  - rs from reputable auditing institutions to improve company performance.
- **The findings of the second hypothesis indicate that risk-taking has a positive and significant influence on value creation. Hence, it is advised that:**
  - Managers utilize market research techniques and analyze environmental data to tailor their risk-taking strategies to the organization's internal conditions.
  - Managers should use their own actions as benchmarks to increase their willingness to take risks.
  - The third hypothesis demonstrates that company size plays a mediating role in the connection between audit quality and value creation. Therefore:
  - Company managers are encouraged to adjust the level of audit quality based on the organization's size, enhancing audit quality as the organization expands.
  - The results of the fourth hypothesis suggest that company size acts as a mediator in the relationship between risk-taking and value creation. Thus:
  - Managers and investors should consider the company's size and its risk-taking behavior, ensuring alignment between these two variables.

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Investigating the Relationship between Firms' Financial Constraints and Cost Stickiness

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Abstract

Objectives: This study aims to rigorously investigate the relationship between financial constraints faced by companies and the phenomenon of cost stickiness. Understanding this relationship is crucial for effective financial management and strategic decision-making.

Design/methodology/approach: To achieve the research objectives, a comprehensive dataset comprising 132 firms listed on the Tehran Stock Exchange was meticulously selected using a systematic exclusion model. The analysis spans an 8-year period from 2015 to 2022. A linear multivariate regression model was employed to robustly test the research hypotheses.

Findings: The empirical results reveal a direct and statistically significant relationship between financial constraints and cost stickiness. This finding indicates that companies experiencing financial limitations tend to exhibit greater cost stickiness, which can adversely affect their operational efficiency.

Innovation: This research contributes valuable insights by demonstrating that effective management of financial crises can significantly mitigate cost stickiness. By highlighting this relationship, the study underscores the importance of proactive financial strategies in enhancing corporate resilience and performance.

Keywords: Financial Constraint, Cost stickiness, Tehran Stock Exchange.

1. Introduction

Cost stickiness occurs when the percentage of cost increase with an increase in the volume of activity is greater than the percentage of cost reduction from decreasing the same volume of activity. This type of spending behavior has been labeled as "sticky costs" by Anderson et al. (2003). Unlike small changes in activity, large changes in activity force managers to adjust the cost structure, altering the firm's products, which ultimately leads to a change in the total cost line. Additionally, managers are more likely to adjust costs when activities increase rather than when they decrease (Balakrishnan et al., 2004). Costs can be classified and described in various ways for different purposes (Namazi et al., 2012). The nature of operations in for-profit units can also impact this classification and description. While manufacturing companies and trading services may face similar costs, the classification and description of these costs may differ between the two types of companies (Nikkar and Heydarinejad, 2015).

Various factors can contribute to cost stickiness or exacerbate it. In today's global economic system, financial constraints are a significant issue for all companies. Financial constraints are not synonymous with economic pressure or the risk of bankruptcy, although they are closely related. When companies become more sensitive to cash flow constraints between domestic and foreign financial costs, their ability to finance is limited. The measurement of profit and its impact play a crucial role in corporate governance, with financial statement users placing great importance on it (Nosrat and Badavar Nahandi, 2018). Financial constraints refer to restrictions preventing financing for all desired investments. The inability to secure funds for an investment may be due to poor credit conditions, an inability to borrow, an inability to issue new shares, or the presence of non-liquid assets. However, financial constraints are not synonymous with financial pressure, and the level of financial constraints varies based on regulatory and governance mechanisms. Internal control can effectively mitigate management self-interest, reduce underlying conflicts, improve operational efficiency, and reduce information asymmetry (Cheng et al., 2014).

The main focus of this study is to explore the impact of financial constraints on a firm's cost stickiness. Cost management is a fundamental aspect of daily firm management and resource planning to maximize profits by effectively managing costs. When managers aim to maximize profits through cost management, there is often an asymmetric relationship between changes in business volume and cost changes, known as cost stickiness (Anderson, 2003). This phenomenon occurs when activity levels increase, leading to increased costs, but when activity levels decrease, costs do not decrease proportionally, resulting in cost stickiness. Financial constraints can exacerbate this issue due to a lack of financial resources to cover costs, creating a challenging situation for companies. Given the uncertain findings regarding the effects of financial constraints on cost stickiness and the gaps in research in this area, as well as the role of financial constraints in managerial decision-making and funding of costs in companies, it is crucial to address this issue.

The structure of the research involves expanding on theoretical foundations, hypotheses, and empirical bases, followed by defining the methodology and research variables, and finally presenting the research findings and conclusions.

Theoretical, empirical, and research hypothesis

Cost stickiness is a characteristic of cost behavior that demonstrates how costs increase more when activity levels increase than they decrease when activity levels decrease (Namazi et al., 2012). Cost management is a crucial aspect of daily business operations, impacting resource planning and profit maximization. The concept of cost stickiness, as discussed by Anderson (2003), highlights an asymmetric relationship between changes in business volume and costs. This phenomenon occurs when costs increase with activity

levels but do not decrease proportionately when activity levels decrease, leading to cost stickiness.

Factors influencing asymmetric changes in firm costs have been explored by Anderson et al. (2003) in the context of resource adjustment by managers to cope with varying business volumes. The stickiness of costs can result from improper resource management, leading to financial constraints (Bradbury & Scott, 2018). While cost adjustment helps understand cost stickiness, companies still need adequate financial support to manage costs effectively.

Financial constraints play a critical role in cost stickiness, affecting a firm's ability to adjust costs and improve performance through cost control (Chen & Ma, 2021). Companies facing financial constraints prioritize cash flow in investment decisions, highlighting the importance of access to capital. Addressing financial constraints is essential for effective cost management and business performance improvement.

In today's global economic landscape, financial constraints pose a significant challenge for companies, impacting their ability to finance desirable investments. Financial constraints should not be confused with economic pressure or bankruptcy risk, although they are interconnected. Companies with severe financial constraints emphasize cash flow in decision-making and face limitations in financing due to internal and external fund allocation costs.

In conclusion, cost stickiness is a critical issue for companies as it can disrupt business operations and hinder goal achievement. Financial constraints can influence the stickiness of costs, underscoring the importance of addressing these constraints to effectively manage costs and enhance business performance.

Research hypothesis

There is a significant relationship between financial constraints and corporate cost stickiness.

Chen and Ma (2021), in a study titled "Financial Constraint, Internal Control, and Cost Stickiness," suggest that managers believe conserving resources is more effective than rebuilding them afterwards. However, financial constraints have introduced uncertainty into resource decisions made by managers. The study analyzed data from manufacturing companies in China from 2009 to 2017, revealing that financial constraints significantly impact companies' cost stickiness. Furthermore, the study found that a low quality of internal control can worsen the relationship between financial constraints and cost stickiness.

Li and Lu (2021), in a study titled "Product Market Competition and Cost Stickiness: Evidence from China," propose that in emerging markets, product market competitiveness reduces costs. The impact of product market competition on cost stickiness is not significantly weakened for companies with a differentiation strategy, but it is significantly weakened for companies with public property rights. Additionally, the financial strength and competitive position of the industry undermine the effect of product market competitiveness on cost stickiness.

Habib and Costa (2021), in their research on the relationship between debt maturity structure and cost stickiness, found that factors such as free cash flows, revenue management incentives, and executive compensation structure affect cost stickiness. Debt limits cost stickiness due to the short maturity of resources. Lee et al. (2020) stated in a study titled "Risk Management and Cost Asymmetry" that cost stickiness increases with managers' risk-taking behavior. They also found a positive but weak relationship between risk and cost stickiness for companies with higher management levels. The study highlighted the moderating effect of managerial preferences in NGOs, less competitive industries, and areas with lower marketing degrees.

Ghanbari and Sawkash Salmasi (2021), in a study on "The Impact of Economic Crisis and Economic Growth on Cost Stickiness," noted that during economic booms, cost stickiness increases, while economic recessions have a negative effect on cost stickiness. Severe economic sanctions negatively

impact cost stickiness, with a significant difference in stickiness observed only in operating costs during normal versus severe sanctions. Farnoudi and Ghajar Beigi (2021), in a study on "The Effect of Financial Distress and Financial Constraint on Commercial Credit of Companies," found that financial constraint positively affects accounts receivable but did not show strong evidence of an impact on accounts payable. The study emphasized the role of financial distress and financial constraint in companies' financing and trade policies.

Fattahi et al. (2020), in a study on "Cost Stickiness and Credit Risk of Banks," concluded that there is a positive and significant relationship between cost stickiness and banks' credit risk. Enayatpour Sheyadeh et al. (2020), in a study on "The Effect of Ownership Concentration on the Relationship between Cost Stickiness and Investment in Fixed Assets in the Tehran Stock Exchange," found a significant inverse relationship between cost stickiness and fixed asset investment, as well as a positive and significant effect of ownership concentration on this relationship. Vaghfi et al. (2019), in a study on "Stickiness Behavior of Costs in Tehran Stock Exchange Firms," observed that the increase in all three levels of cost for the same increase in activity level is greater than the reduction in these costs for the same decrease in activity level, indicating sticky cost behavior in the companies surveyed. Additionally, the study found an increase in total operating costs.

Pourshiade et al. (2019) conducted a study titled "The Effect of Ownership Concentration on the Relationship between Cost Stickiness and Corporate Risk of Firms Listed on the Tehran Stock Exchange," which found that cost stickiness significantly increases a firm's level of risk. Additionally, they discovered that ownership concentration, a key component of corporate governance, has a negative and significant impact on the relationship between cost stickiness and corporate risk.

In another study, Hajiha et al. (2019) explored "The Impact of Managers' Short-Term Attitude on Cost Stickiness of Firms Listed on the Tehran Stock Exchange." They emphasized the importance of understanding cost behavior in accounting and finance, highlighting how cost stickiness reflects managers' motivations in cost control. Their research revealed that managers' short-term attitude is negatively and significantly related to cost stickiness.

Namazi and Fathali (2018) investigated "The Effect of Intellectual Capital and Free Cash Flow on Cost Stickiness of Firms Listed on the Tehran Stock Exchange." Their findings indicated a significant inverse relationship between free cash flow and sales, administrative, and public costs. They also noted that both free cash flow and intellectual capital influence the stickiness of these costs, further supporting an anti-sticky relationship.

In a study by Etemadi and Ahmadi (2015), it was concluded that political relations with the government can alleviate financial constraints for companies. Companies with ongoing political connections tend to overcome financial obstacles more easily.

Hajiha and Mohammad Hossein Nezhad (2015) analyzed factors contributing to internal control weaknesses within firms. Their study, which included 97 companies listed on the Tehran Stock Exchange, examined the impact of eight explanatory variables on internal control weaknesses. The results of the regression analysis revealed a positive and significant relationship between the logarithm of stock price, inventory-to-total asset ratio, and losses with internal control weaknesses. Other variables such as exchange rate, income growth, market value per book value, Altman index, and total debt to assets ratio showed no significant relationship with internal control weaknesses.

Research Methodology

Due to the basic theoretical foundations related to the variables under study, the present research is classified as applied research in terms of its purpose and method of execution. This classification is due to the lack of manipulation of independent variables to observe their impact on dependent variables, as well as the descriptive-causal nature of the study, which aims to

investigate variables in their natural state without interference.

Historical and post-event data were collected using library and archival methods to test the research hypotheses. The statistical population of the study consists of all firms listed on the Tehran Stock Exchange, excluding companies with financial periods ending other than in March, those that changed their financial period during the research period, companies with insufficient information for comparability, and investment companies, banks, and insurance companies. To ensure data homogeneity, 132 companies were selected through a systematic screening process, and their data were collected for an 8-year period from 2015 to 2022, similar to previous studies.

Regression analysis was conducted using Eviews12 software, along with robust standard error tools and appropriate statistical tests to evaluate the final hypotheses.

Regression model:

$CS_{i,t} = + \beta \beta 0_1 KZ_{i,t} + \beta 2 LEV_{i,t} + \beta 3 SIZE_{i,t} + \beta_4 ROA_{i,t} + \beta 5 MTB_{i,t} + \varepsilon_{i,t}$

Operational Definitions of Research Variables

Independent research variable: Financial constraint (KZ)

Firms face financial constraints when there is a disparity between internal and external expenditures of allocated funds. According to this definition, all companies can be considered limited in financial terms, but the levels of financial constraint vary. Less limited financial entities are those with higher liquidity assets and high net assets. In this research, financial constraint is a binary variable (0 and 1) used to measure the financial constraint of the Kaplan and Zeinglas index. This index has been adapted for the Iranian environment by Raee and Hesarzadeh (2009) and is calculated using the following equation. The KZ score is then ranked from smallest to largest, divided into five parts, and companies in quintiles four and five are identified as having financial constraints.

KZ = 17.33 – 37.486 * (Cashholding/ Total Assets) – 15.21 * (DIY/ Total Assets) + 3.39 * LEV – 1.402 * (M/B)

Cashholding: Net cash flow of the firm divided by the firm's total assets
Total Assets of the Firm
D IY: Corporate Dividend Ratio to Assets
LEV: Total corporate liabilities divided by total assets
M/B: Ratio of market value of equity to book value (Nosrat and Badavar nahandi, 2018).

The dependent variable of research: Cost adhesion (CS)

Cost stickiness was first proposed by Anderson et al. (2003). Cost stickiness is a type of cost behavior that shows how costs change in response to changes in income over a period of time. Anderson et al. utilized a regression model in their study, as described by Kordestani (2020). Rimmer (2018) and Hamburg (2018) also used a similar model to measure cost stickiness. The remaining part of the model indicates the degree of stickiness of the costs.

$$log\left(\frac{\text{SGAt}}{\text{SGAt}-1}\right) = \beta_0 + \beta_1\, log\left(\frac{\text{Salest}}{\text{salest}-1}\right) + \beta_2\, Dt * log\left(\frac{\text{Salest}}{\text{salest}-1}\right) + e$$

In the above relationship:
SGA: Sales, administrative, and general expenses for the current year (operating cost).
SGAt-1: Sales, administrative, and general expenses in the previous year.
Sales: Total sales revenue for the year.
$Sales_{t-1}$: Total sales revenue in the previous year.
D: The model is a fictitious variable that has two values (0 and 1). This variable is assigned the number (1) if the current year's sales revenues have decreased compared to the previous year (i.e., periods of decline

in sales) and the number (0). The remainder of the model is used as cost adhesion (Fattahi, Kordestani, and Rastgooian, 2020).

Control variables of research

ROA (Return on Corporate Assets): To calculate this variable, the net dividend before interest and taxes on total assets are used.

SIZE (firm size): To calculate this variable، the natural logarithm of the sum of assets is used.

LEV (Corporate Leverage): To calculate this variable, the sum of the total liabilities divided by the total sum of assets is used.

MTB (Growth Opportunity): To calculate this variable, the division of the market value of the capital by the book value of capital is used at the end of the fiscal year.

Research Findings

Descriptive statistics of research variables

Table 1 displays the descriptive statistics of the research variables. The primary central indicator is the average, which signifies the equilibrium point and center of gravity of the distribution and serves as a good indicator of the centrality of the data. For instance, the average value for the leverage variable is 0.56, indicating that the majority of the data is centered around this point. This suggests that, on average, companies have 50% of their assets accounted for as liabilities. Generally, dispersion parameters are used as criteria for determining the amount of dispersion from one another or their dispersion rate relative to the average. One of the most crucial parameters of dispersion is the standard deviation. The value of this parameter for growth opportunity (market value to book equity) is 3.18 bps, while for the adhesion variable cost it is 10%, signifying that these two variables have the highest and lowest standard deviations, respectively. Thus, the market value of the companies in the sample displays a higher dispersion compared to other information regarding their book value. The lowest and highest values in each variable vary. For example, the largest amount of leverage is 1.04 bps.

As can be seen in Table 2, the total year total of the companies surveyed is 1056 cases, of which 423 cases (40.06% of the year-companies) were limited financially, and 633 cases (59.94%) of the year-companies had no financial constraints.

According to the results obtained in Table 3, it is observed that the significance level of variables in the stability test is less than 5% and indicates the stability of the variables.

According to the results obtained in Table 4, it is observed that the significance level of the test for the research model is higher than 5% and the application of the common effects model (integrative) is preferable to the fixed effects model, so in this situation it is not necessary to present the Hausman test (Banimahd et al., 2016).

The results in Table 5 show that the significance level of the test in the research model is less than 5%, indicating the presence of variance inconsistency in the disruptive sentences. This issue is resolved by implementing the GLS command in the final estimation of the models. Additionally, the significance level of the serial autocorrelation test in the research model is more than 5%, suggesting the absence of serial autocorrelation in the models.

Table 1: Descriptive statistics of quantitative variables

Variable	Mean	Min	Max	S. dev.
CS	0.0005	0.45	-0.30	0.10
LEV	0.56	1.04	0.10	0.20
MB	4.12	10.87	-0.55	3.18
ROA	0.13	0.45	-0.053	0.13
SIZE	14.60	18.68	11.64	1.47

Table 2: Variable Frequency Distribution of Financial Constraints

Variable	Value	Frequency	Percent Frequency
Kz	1	423	40.06
Kz	0	633	59.94
Total	-	1056	100

Table 3: Stability Test Quantitative Variables

Variable	Test Statistics	Sig	Results
CS	-16.8583	0.0000	Stationary
LEV	-82.3447	0.0000	Stationary
MB	-10.3771	0.0000	Stationary
ROA	-31.4487	0.0000	Stationary
SIZE	-19.4103	0.0000	Stationary

Table 4: F-Limmer Test

Test Model	Test Statistics	Sig
F Leamer	1.43	0.19

Table 5: Variance Heterogeneity Test Results

Test Model	Test Statistics	Sig
White	12.40	0.0000
Breusch-Godfrey	0.40	0.20

Table 6: Hypothesis of a Hypothesis

$CS_{i,t} = + \beta \beta 0_1 KZ_{i,t} + \beta 2 LEV_{i,t} + \beta 3\ SIZE_{i,t} + \beta 4\ ROA_{i,t} + \beta 5\ MTB_{i,t} + \varepsilon_{i,t}$					
Dependent Variable: Cost stickiness					
Variables	**Coefficients**	**Std**	**Statistic t**	**Sig**	**VIF**
Kz	0.048	0.023	2.09	0.036	1.11
LEV	0.069	0.011	5.93	0.0000	1.14
SIZE	0.012	0.003	3.83	0.0007	1.07
ROA	-0.94	0.049	-19.12	0.0000	1.41
MB	0.069	0.083	0.84	0.40	1.38
C	0.48	0.050	9.68	0.0000	-
Coef	0.33				
Watson Durbin	1.98				
F	42.48				
Sig	0.0000				

The results from Table 6 indicate that the financial constraint variable, with a positive coefficient of 0.048 and a significance level below 5% (0.036), has a direct and significant relationship with the firm's value. Since the hypothesis test's condition for confirmation is below 5%, the first hypothesis of the research is accepted with a 5% error level. Control variables, except for the opportunity to grow the firm, have a significant relationship with the dependent variable of the research at a significance level below 5%. The coefficient of determination is 33%, suggesting that the independent and control variables in the model

explain 33% of the dependent variables. Watson's camera value is 1.98, indicating no correlation between the disruptive sentences of the autocorrelation model. Test statistics for the research model, with a significance level below 5%, show a good fit. Additionally, the collinearity statistics (VIF) are below 5 and around 1, suggesting no strong correlation between the research variables.

Research Results

The main purpose of this study is to investigate the role of internal controls on the relationship between financial constraints of companies and cost stickiness. Cost stickiness is a characteristic of cost behavior that shows the rate of increase in costs when the activity level increases is greater than the rate of cost reduction when the activity level decreases.

Statistical discussions reveal that the financial constraint variable, with a significance level below 5%, has a direct and significant relationship with the stickiness of a firm's cost. Financial constraint refers to hindrances in financing all desirable investments. Cost management is a crucial aspect of daily firm operations.

While cost adjustment helps in understanding cost stickiness, companies still require sufficient financial support to offset costs. Supply Costs Financing, which leads to financing constraints for companies, suggests that financing constraints affect cost stickiness through cost adjustment.

The results of the first hypothesis of the research indicate a direct relationship between financial constraints and cost stickiness. When companies face financing constraints, they encounter problems in compensating for costs. Despite financial constraints, the firm's investments decrease, leading to higher cost levels and increased stickiness. As financial constraints increase, the level of stickiness also rises.These findings align with the research conducted by Chen and Ma (2021). In addition, Beigi Vaghfi, et al. (2019) have found that financial constraints have a significant impact on payments, cost compensation, and the financial performance of a firm is linked to cost adhesion. The results of the first hypothesis suggest that companies that plan ahead and utilize financial experts are able to adjust their spending levels during different periods in line with inflation and market fluctuations, thus avoiding cost stickiness during sales downturns. The research indicates that it is crucial for firm managers to maintain adequate resources to navigate financial crises and constraints, ensuring that financing costs do not escalate. Investors and shareholders in the capital market are advised to carefully analyze financial statements and corporate information to make informed decisions about future investments and identify companies facing crises. Future research should explore the influence of corporate credit ratings on cost stickiness during financial hardships.

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Providing a Model of Privatization with Emphasis on Financial and Non-financial Factors

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Abstract

Objectives: This study analyzes the components of privatization, assigns weights to these components, and develops a privatization model based on financial and non-financial factors. Design/methodology/approach: The research employs purposeful, explanatory, and exploratory methods to identify privatization patterns. Utilizing the Delphi method and structural interpretive modeling, data was collected from existing literature and insights gathered from managers and policymakers in privatization organizations. Six criteria were established as key components of privatization: economic factors, financial and accounting criteria, political factors, promotion of the private sector, government performance, and cultural/public dimensions. A hierarchical approach was used to construct a tree structure for evaluating options based on these criteria. Expert Choice software was utilized to prioritize components and propose an optimal model.

Findings: The findings indicate that political factors ranked highest among the components, followed by economic factors, financial and accounting criteria, and promotion of the private sector at the second level. Government performance and cultural/public dimensions were rated at the third level.

Innovation: The results could significantly impact decision-making in the private sector by enhancing efficiency. By prioritizing key components of privatization, this research suggests potential changes to current decision-making practices within the privatization sector.

Keywords: Financial factors, Non-financial factors, Privatization, Privatization components.

1. Introduction

Privatization is a process in which ownership of companies and assets is transferred from the public sector to the private sector. This phenomenon is known to increase the efficiency of these entities. The private sector, once it acquires the share of the public sector, becomes one of the pillars of the economy. Active privatization of public sector companies means that financial resources and management control are no longer in the hands of the public, but rather in the hands of private individuals. Resources for these organizations are sourced from the private sector, not the public sector.

With this introduction, it can be said that when the shares of a government company are transferred to a non-governmental institution in privatization programs, although this action is also counted among the statistics of transfers in privatization, it should be noted that privatization, when economically feasible, can be the origin of the transformation in the efficiency of companies. The transfer of assets from the public sector to the private sector and neglecting specialized approaches in the field of financial and non-financial factors that determine privatization require very high costs. Therefore, by explaining the necessity and relevant details in this research, the intention is to draw the pattern of privatization with emphasis on financial and non-financial factors. In this research, an attempt has been made to present a model of privatization with an emphasis on financial and non-financial factors to open new doors on this issue.

2. Importance of research

Considering the positive and effective economic activities of governments in the 1950s and 1960s, there was gradual expansion in the range of activities. However, problems such as severe bureaucracy, weak management systems, lack of proper evaluation and audit systems, lack of work motivation, multiplicity of goals, use of monopolies, and inefficient support arose. These issues caused inefficiency to dominate the economic activities of governments in the 1970s and 1980s, leading to failures in achieving their goals (Zarenejad et al., 2012). Consequently, most governments in the last two or three decades attempted reforms, such as removing support for companies from domestic and foreign competition, eliminating the possibility for companies to obtain cheap credit facilities, creating tough budgetary obstacles, non-commercializing companies, creating independence in the management and administration of companies, reducing customs and trade tariffs, and using performance evaluation mechanisms to hold managers accountable. However, the results of these reforms were unsatisfactory in most countries due to difficulties in increasing efficiency, guaranteeing management independence, and applying financial discipline in government bureaucracy organizations (Malaki, 2022).

As a result, governments widely support the tendency towards the self-organizing mechanism of the market sector, along with policies of liberalization, deregulation, and privatization, including the transfer of ownership and management, as rational strategies to address economic issues and problems and increase efficiency (Mehdizadeh et al., 2021). In Iran, the privatization policy was proposed as the first economic, social, and cultural development program to transfer the government's economic activities to the private sector. Since then, the success of the privatization policy has become a complex economic concern for officials and managers, sparking many discussions (Mehri et al., 2023).

Over the past decades, governments established numerous state-owned enterprises to achieve development goals and maximize social welfare. However, due to unfavorable economic-financial results in recent years, lack of technical-economic and financial justification for government intervention in

some production processes, and financial-economic limitations for managing and undertaking activities, the implementation of the privatization policy for state-owned companies became necessary. The high volume of government involvement in the economy, presence of state-owned companies in unnecessary economic activities, low competitiveness at national and international levels, lack of development in the private sector, weakness of the capital market, and improper resource distribution between government and non-government sectors led to the ineffectiveness of the government. Therefore, transferring economic activities to the private sector and reducing government involvement was proposed as a solution to economic problems and growth.

Financial performance criteria, such as return on equity and average return on equity, are crucial dimensions for evaluating the success of privatization programs. By comparing the performance of companies before and after privatization, the impact of financial and non-financial factors can be assessed to determine the success or failure of privatization. It is essential to consider these key criteria when strategizing privatization to ensure success.

Extensive field data shows

that both financial and non-financial criteria are essential for successful privatization. Establishing a suitable model and understanding these criteria is crucial for effective privatization. Questions that arise in this area include determining the pattern of privatization with emphasis on financial and non-financial factors, as well as its dimensions.

3. Literature Review

Public dissatisfaction with government enterprises is increasing in most countries due to the high prices and poor quality of goods, especially commercial goods and services, and manufactured products. Government enterprises are unable to properly distribute their products and services.

Evidence shows that in most countries, many government enterprises are not only inefficient and unproductive, but also do not help increase the resources and income of the government. Additionally, due to attracting various aids and subsidies, they increase government expenses (Star, 2019).

The inefficiency and poor quality of goods and services provided by some government companies are a result of weak competition or their monopoly position in the market.

There are several economic reasons for privatization, with the most important being the beneficial impact of competition. If privatization does not foster more competition, it may not be very successful (Tribes and Polit, 2019).

In Iran, the policy of privatization and transferring government companies, based on the provisions of Note 32 and the policies of the country's first development plan in 1370, was implemented with the issuance of the first official government statement. To date, there has been no research on identifying privatization components and prioritizing them. While some similar research has been conducted, we can refer to Jandaghi Ardakani et al. (2023) with the title "Investigating financial and non-financial factors influencing investors' decisions in the stock exchange." Their results showed that both financial and non-financial factors impact investors' decisions.

Mousaviyan et al. (1400) concluded in their research titled "Evaluation of the effects of privatization on the financial dimensions and profitability of companies listed on the Tehran Stock Exchange" that privatization has improved the financial dimensions of listed companies.

Rostam Khani et al. (2020) conducted a study titled "Investigation and Estimation of the Impact of Privatization on the Financial Dimensions of Government Companies." Their findings revealed that after privatization, return on equity increased, net profit growth rate increased, and the sales to total assets ratio decreased.

Kaiser et al. (2023) conducted a study titled "The effect of the privatization process on productivity

indicators and financial dimensions of companies." Their results showed that privatization significantly impacted capital productivity and return on assets in the studied companies, leading to an increase in these indicators.

Noti (2023) examined the impact of privatization on financial dimensions, growth, and learning of employees. Their research demonstrated that privatization improved financial dimensions, growth, and learning of employees.

Radik et al. (2021) conducted a study titled "Evaluation of the impact of financial aspects and privatization on the technical efficiency of companies." Their research utilized the random frontier analysis method to estimate companies' technical efficiency and the panel data method to measure the effect of financial aspects on efficiency. Results showed a decrease in technical efficiency of 28 companies after entering the stock market, highlighting the negative and significant impact of liquidity ratios and return on equity on companies' technical inefficiency.

4. Research method

This research is based on the purpose of being explanatory and exploratory. It aims to determine the pattern of privatization, with emphasis on financial and non-financial factors, using the Delphi method and structural-interpretive modeling. The data collection for this research is mixed.

4.1 Statistical population

The statistical population for this research consisted of experts in the privatization organization who met the following criteria: a minimum of 3 years of managerial experience, expertise in the subject matter, availability, and willingness to participate in the study. Therefore, the sampling method employed in this section was purposeful sampling. The rationale behind this choice of sampling method is as follows: Probability sampling is utilized when the researcher aims to generalize the findings from the sample to the population. However, if generalization is not the goal, purposive sampling can be used. In qualitative research, researchers often opt for purposive sampling. For this study, 15 experts from the privatization organization were invited to participate.

4.2 Research path

According to the studies conducted in this research to identify the components of privatization with an emphasis on financial and non-financial factors, the following factors were obtained during interviews with 15 experts from privatization organizations:

A. Financial factors include economic factors, financial criteria, and accounting criteria.
B. Non-financial factors include political factors, promotion of the private sector, government performance, and cultural and public dimensions.

4.3 Identification of effective criteria and hierarchical construction

In the process of identifying these sub-criteria, the content analysis approach was used. There were a total of 78 sub-criteria in the form of factors related to the optimization of economic frameworks in the country, the development of the country's economic activity environment, financial and accounting dimensions, internal policy framework, political perspective, current policy framework, international and extraterritorial politics, political challenges, promotion of private sector capabilities, evaluation of government performance in supporting the private sector, management standards, entrepreneurship and support standards, laws and regulations, and development of privatization culture and actions in these areas.

To validate the findings of the research, the content validity index (CVI) developed by Waltz and Basel was used. Experts were asked to rate the

relevance of each item on a four-part spectrum: 1-not relevant; 2-needs major revision; 3-relevant but needs revision; 4-fully relevant.

The number of experts who chose options 3 and 4 was divided by the total number of experts. If the resulting value was less than 0.7, the item was rejected. If it fell between 0.7 and 0.79, it needed revision. If it was greater than 0.79, it was considered acceptable.

Table 1. Experts' references to privatization components according to financial and non-financial factors

under the criteria	CVI	Experts	situation
Planning to liberalize the economy of the country	0.86	13	✓
Focusing on the development and promotion of the capital market and stock market	0.956	11	✓
Planning for the full use of the capacities of banks and financial institutions	0.968	10	✓
Planning to update the relevant administrative cycles and remove obstacles in the way of privatization	0.908	8	✓
Providing the right space and platform to accelerate and facilitate privatization	0.812	12	✓
Planning for development and integrated pricing system	0.971	9	✓
Creating a consistent approach among planning and policymaking organizations with implementers	0.917	9	✓
Planning to create and promote stability in the pillars of the economy	0.936	10	✓
Focus on creating employment and developing entrepreneurship	0.877	9	✓
Planning to reduce the economy's dependence on oil	0.983	8	✓
Planning to connect companies with the international market	0.968	9	✓
Emphasis on ensuring investment security and the entry of the private sector into the market	0.843	9	✓
Productivity and high efficiency of private sector investment	0.829	7	✓
Continuous support to the private sector with the approach of empowering the private sector to compete	0.907	9	✓
Defining the standard and comprehensive financial and accounting structure for companies before handover	0.881	7	✓
Emphasis on complete and transparent financial information of the companies included in the privatization plan	0.983	8	✓
Complete and transparent access of regulatory bodies to information and financial transactions of companies and organizations included in the plan	0.892	11	✓
Emphasis on the competitive cost in the audit of companies and organizations included in the privatization plan	0.938	10	✓
Emphasis on the detailed and specialized study of asset pricing before handing over	0.926	12	✓
Using the benefit-cost standard based on the latest specialized accounting guidelines	0.784	8	✓
Continuous and accurate auditing and screening of existing discrepancies and explicit and clear actions to prevent repetition	0.764	11	✓
The unanimity of the implementation of Article 44 of the Constitution even despite the shift in power of political factions	0.968	9	✓
Alignment of decision-making and policymaking authorities in the field of privatization with the political dimensions of the country	0.91	10	✓
Emphasis on the special interaction between related institutions and decision-makers in the field of privatization	0.885	7	✓
The existence of common goals among officials executives and planners in the field of privatization	0.86	8	✓
Emphasis on political stability	0.946	10	✓
Accurate explanation of the ruling political goals and approaches	0.987	11	✓
Political flexibility at the level of the country and the degree of society's companionship and alignment with the thinking that governs domestic politics	0.885	6	✓
Emphasis on political support for privatization	0.892	8	✓

under the criteria	CVI	Experts	situation
Emphasis on the pillars of the country's foreign policy and adherence to political ideals	0.891	6	✓
Emphasis on the detailed analysis of the policies of the countries in the region and other related countries	0.968	9	✓
Planning to use domestic capacities and privatization to overcome international sanctions	0.88	8	✓
Avoiding any influence of individuals and factions in privatization planning	0.862	12	✓
Avoiding any consolidation and prescriptive planning in the field of privatization	0.878	9	✓
Focusing on supporting the alignment of privatization plans and meeting the general needs of the people	0.86	8	✓
Preventing political approaches and decisions and changing existing approaches	0.833	9	✓
Focus on continuous support of the private sector in the frameworks	0.86	9	✓
Planning to eliminate possible rents in the course of privatization	0.956	7	✓
Defining specialized frameworks to strengthen and develop privatization infrastructures	0.979	6	✓
Focus on strengthening the non-governmental sector and tackling the underground economy	0.99	11	✓
Planning for the development of organizational structure in private companies	0.935	13	✓
Planning to define specialized standards in privatized companies	0.866	8	✓
Planning for private companies to enter the capital market	0.825	9	✓
Existence of legal incentives for private sector investment	0.893	9	✓
Focus on continuous support of the private sector in the frameworks	0.799	6	✓
Planning to eliminate possible rents in the course of privatization	0.816	8	✓
Defining specialized frameworks to strengthen and develop privatization infrastructures	0.886	9	✓
Focus on strengthening the non-governmental sector and tackling the underground economy	0.86	11	✓
Planning for the development of organizational structure in private companies	0.946	11	✓
Planning to define specialized standards in privatized companies	0.86	8	✓
Planning for private companies to enter the capital market	0.86	12	✓
Existence of legal incentives for private sector investment	0.843	12	✓
Planning to create and upgrade the necessary infrastructure for the development of privatization	0.831	13	✓
Making the private sector more efficient with scientific planning and using public capacities	0.902	8	✓
Cohesion of the public sector to cooperate with the private sector and use existing capacities	0.827	15	✓
Focusing on improving and upgrading the necessary standards for the transfer of equity shares	0.888	12	✓
Separating the duties of the private and public sectors and equipping the private sector to play an effective role in economic development	0.793	13	✓
Planning to define specialized frameworks for the entry of foreign investments	0.797	9	✓
Defining the rules and regulations necessary to make the companies subject to the privatization plan accountable	0.832	12	✓
Using the will of the government to clarify the activities of companies and organizations included in the privatization plan	0.891	14	✓
Paying special attention to the cooperative sector and developing regulations and specialized rules for the cooperative sector	0.956	10	✓
Planning for the use of knowledge and expertise, following the development needs of the companies included in the plan	0.798	9	✓
Planning to properly deal with the resistance of underemployed public sector managers in the field of privatization	0.824	14	✓
Use of expert working groups and decisions based on real data to streamline privatization	0.837	12	✓
Taking advantage of the research and scientific management capacities of companies and organizations included in the privatization plan	0.86	10	✓
Focusing on the continuous monitoring of the activities of the included companies and the existence of legal solutions to monitor and deal with the shortcomings or violations in this area.	0.854	13	✓

under the criteria	CVI	Experts	situation
Accurate reporting of the performance of companies and organizations included in the privatization plan	0.869	11	✓
Development of a comprehensive tax and property system to control the financial activities of companies and organizations included in the privatization plan within legal frameworks	0.906	10	✓
Planning to promote support and financial incentives to motivate the entry of the private sector into government processes	0.912	8	✓
Paying attention to visas for private sector entrepreneurs and defining specialized support frameworks	0.816	12	✓
Using tax and capital incentives to motivate the private sector	0.968	9	✓
Reducing the benefit of facilities granted to service sectors included in the privatization plan	0.882	9	✓
Legal protection of the companies and organizations involved after the handover	0.956	10	✓
Transparency and comprehensiveness of laws and regulations in the field of privatization	0.968	9	✓
Protections of Labor Laws and Social Security	0.961	8	✓
Reducing and removing customs barriers, trade barriers, and financial transactions of the companies included in the plan within the framework of governance laws	0.827	9	✓
Continuous and organized controls by supervisory institutions on the performance of companies and organizations subject to the privatization plan	0.968	9	✓
Focusing on scientific and practical studies based on up-to-date and documented data before handing over	0.903	7	✓
Invoking religious and belief dimensions and following Sharia and customs in privatization programs	0.797	9	✓
Planning to prevent ethnic and cultural views from entering the privatization process	0.832	12	✓
Emphasis on promoting public trust in the private sector	0.891	14	✓
Laying the groundwork for the entry of small capital into the privatization process	0.956	10	✓
Emphasis on clarifying the goals of privatization and promoting public knowledge in this field	0.798	9	✓
Eliminating value conflicts between the government and the private sector	0.824	14	✓
Planning to avoid past unsuccessful experiences in privatization	0.837	12	✓
Plan to avoid any chaos or resistance to change	0.86	10	✓

Source: Research finding

Based on the suggestions provided by experts in the feedback forms, as well as through open-ended and selective coding, the components of privatization were identified. Emphasis was placed on both financial and non-financial factors, resulting in a total of 78 components under the main criteria outlined in the table above. This provides certainty for the next steps, which will be carried out in rounds. The criteria and corresponding numbers are detailed in the table below.

Privatization components were identified by focusing on both financial and non-financial factors using a Delphi panel questionnaire. The arithmetic mean of important criteria was used to compare the dimensions. Experts then used verbal variables such as "very much," "much," "unimportant," "little," and "very little" to express the level of importance of each criterion from their perspective. Based on the proposed option and defined linguistic variables, the results from analyzing the questionnaire responses were used to calculate the average of the components. If the difference between the averages in the first and second rounds is less than the threshold of 0.1, the polling process is stopped.

Table 2. Dispersion of questions related to research variables

Component	Arrangement	N
Economic factors	C1-C14	14
Financial and accounting standards	C15-C21	7
Political factors	C22-C36	15
Promotion of the private sector	C37-C44	8
Government performance	C45-C69	25
Cultural and public dimensions	C70-C78	9
Total	C1-C78	78

Source: Research finding.

Table 3. The difference between the geometric means of the second and third rounds

AVE2	AVE1	DIFF	Code	AVE2	AVE1	DIFF	Code	AVE2	AVE1	DIFF	code
4.3333	4.4	-0.0667	C53	4	3.9333	0.0667	C27	3.8	3.8667	-0.0667	C1
4.2	4.2667	-0.0667	C54	4	4	0	C28	4.0667	4.0667	0	C2
3.8	3.8	0	C55	4.0667	4	0.0667	C29	4.4	4.4667	-0.0667	C3
4.2667	4.2667	0	C56	4.1333	4.1333	0	C30	4.2	4.2	0	C4
4.0667	4	0.0667	C57	3.4667	3.5333	-0.0667	C31	3.8667	3.8667	0	C5
3.5333	3.4667	0.0667	C58	4.2	4.2667	-0.0667	C32	4.3333	4.4	-0.0667	C6
3.5333	3.4667	0.0667	C59	3.7333	3.8	-0.0667	C33	3.8	3.8667	-0.0667	C7
4	3.9333	0.0667	C60	3.6667	3.6	0.0667	C34	4.4	4.4	0	C8
4.1333	4.1333	0	C61	3.4	3.4	0	C35	4.2	4.2667	-0.0667	C9
3.7333	3.8	-0.0667	C62	3.7333	3.6667	0.0667	C36	4	4	0	C10
3.7333	3.6667	0.0667	C63	4.4667	4.4	0.0667	C37	3.8	3.8667	-0.0667	C11
4.4	4.4	0	C64	3.8	3.8667	-0.0667	C38	3.8	3.8	0	C12
3.8	3.8667	-0.0667	C65	4.4	4.4	0	C39	4.3333	4.4	-0.0667	C13
4.1333	4.0667	0.0667	C66	4.2	4.2667	-0.0667	C40	4.1333	4.1333	0	C14
4	4	0	C67	4	4	0	C41	4.2667	4.2667	0	C15
3.5333	3.4667	0.0667	C68	3.8	3.8667	-0.0667	C42	3.8667	3.8	0.0667	C16
4.5333	4.6	-0.0667	C69	3.8	3.8	0	C43	3.9333	3.8667	0.0667	C17
4	4	0	C70	4.3333	4.4	-0.0667	C44	4.0667	4	0.0667	C18
4	3.9333	0.0667	C71	4.1333	4.1333	0	C45	3.9333	3.9333	0	C19
4	4	0	C72	4.2667	4.2667	0	C46	4.2667	4.2	0.0667	C20
4.0667	4	0.0667	C73	3.8667	3.8	0.0667	C47	3.5333	3.4667	0.0667	C21
4.1333	4.1333	0	C74	3.9333	3.8667	0.0667	C48	4.1333	4.0667	0.0667	C22
3.4667	3.5333	-0.0667	C75	4.0667	4	0.0667	C49	4	4	0	C23
4.2	4.2667	-0.0667	C76	3.9333	3.9333	0	C50	3.5333	3.4667	0.0667	C24
3.7333	3.8	-0.0667	C77	4.2667	4.2	0.0667	C51	4.5333	4.6	-0.0667	C25
3.6667	3.6	0.0667	C78	4.4	4.4667	-0.0667	C52	4	4	0	C26

Source: Research finding.

Because the difference in the average opinion of the experts in the last two rounds is equal to or less than 0.1, it can be said that the experts have reached a consensus on the components of privatization, with an emphasis on financial and non-financial factors.

4.4 Kendall's coordination coefficient

In this research, Kendall's coefficient of concordance was utilized to assess the level of agreement among panel members. Kendall's coefficient of concordance is a measure used to determine the extent of agreement and concordance among multiple rank categories associated with N objects or individuals. By employing this measure, it becomes feasible to identify rank correlation among K rank sets. This measure is particularly valuable in studies focusing on "internal validity." Kendall's coefficient of concordance indicates that individuals who have ranked multiple categories based on their significance have applied consistent criteria in evaluating the importance of each category and are in agreement with one another in this regard.

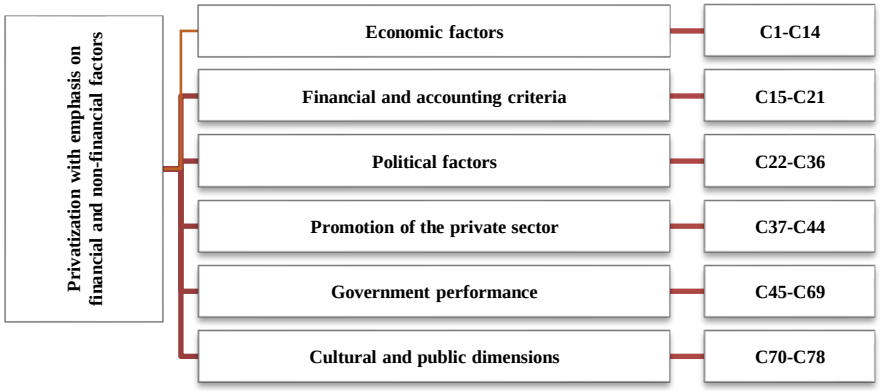
Considering the Kendall coefficient is over 50%, along with the results of a significant number of dimensions falling within the acceptable range of less than 0.05 in the third round, it is evident that the experts have reached a consensus in this round. Therefore, there is no need to continue the Delphi process. The hierarchical trees display indicators and decision options, leading to a series of pairwise comparisons to determine the weight of each factor in relation to competing options. Ultimately, the AHP logic combines the matrices obtained from pairwise comparisons to arrive at the optimal decision

Table 4. Statistical test of Kendall's correlation coefficient

Criterion	round2		round1		df	Arrangement	N
	Sig	W	Sig	W			
Economic factors	0.028	0.591	0.048	0.432	13	C1-C14	14
Financial and accounting criteria	0.017	0.542	0.042	0.352	6	C15-C21	7
Political factors	0.026	0.561	0.055	0.374	14	C22-C36	15
Promotion of the private sector	0.022	0.586	0.037	0.397	7	C37-C44	8
Government performance	0.041	0.539	0.066	0.364	24	C45-C69	25
Cultural and public dimensions	0.009	0.608	0.022	0.459	8	C70-C78	9

Source: Research finding.

Table 5. Matrix table of pairwise comparison of criteria and hierarchical tree of privatization components with emphasis on financial and non-financial factors



Source: Research finding.

In the AHP method, the weight of each criterion is not assumed to be the same. For this reason, Professor Saati invented a method that can calculate and measure the effect of criteria on each other and the entire research operation. The weight of each criterion will be determined by the expert judgment group. The working method is the same as the previous round, but first, the first-level criteria will be recorded in a table that has two vertical and horizontal columns based on the preference table. In this round, the data collection operation ends, and the data is introduced to the software for calculation. Based on the output of the Expert Choice software and the analysis of the research questionnaires, the value matrix has been determined as shown in the table below.

The Interpretive Structural Model (ISM) was introduced by Andrew Sage in 1977. This method involves identifying the fundamental factors first, and then, using the presented method, determining the relationships between these factors and how progress can be achieved through them. ISM analyzes the relationships between indicators by examining criteria at various levels. The ISM model can determine the interdependence between indicators, whether individually or collectively.

Table 6. Pairwise comparison of options

Rank			A1	A2	A3	A4	A5	A6
Second	0.202	Economic factors A1						
Fourth	0.171	Financial and accounting criteria A2	3.00					
First	0.226	Political factors A3	4.00	5.00				
Fifth	0.119	Promotion of the private sector A4	3.00	3.00	3.00			
Sixth	0.084	Government performance A5	3.00	4.00	1.00	5.00		
Third	0.191	Cultural and Public Dimensions A6	4.00	3.00	5.00	3.00	4.00	

Source: Research finding.

4.5 Forming the structural self-interaction matrix

The Structural Self-Interaction Matrix (SSIM) consists of dimensions and indicators of study, which are compared using four modes of conceptual relations. This matrix is completed by process-oriented experts and specialists. The information obtained is based on the method of interpretive structural modeling for summation, resulting in the final Structural Self-Interaction Matrix. Interpretive Structural Modeling (ISM) logic operates using non-parametric methods and is frequency-based.

To clarify, the table above is being used to illustrate the structural self-interaction matrix of all three main criteria being investigated. The structural self-interaction matrix of the research variables is as follows:

Table 7. Symbols used for the structural autocorrelation matrix

(O_{ij})	(X_{ij})	(A_{ij})	(V_{ij})
lack of communication	Two-way relationship	Variable j affects variable i	the variable affects variable j

Source: Research finding

The resulting matrix is created by converting the structural self-interaction matrix into a binary matrix with values of zero and one. To generate the resulting matrix, the signs X and V in the self-interaction matrix are replaced with the number one, while the signs A and O are replaced with the number zero in each row. This resulting matrix is referred to as the initial resulting matrix, with the main diagonal elements all equal to one. Once the matrix has been transformed into a binary matrix, a secondary matrix needs to be created. In the resulting matrix, secondary connections

must be verified for accuracy. For example, if A influences B and B influences C, then A should also influence C. If direct effects were expected based on secondary connections but were not observed in practice, the table should be adjusted to reflect these secondary relationships.

Table 8. Structural self-interaction matrix of privatization components with emphasis on financial and non-financial factors

	A1	A2	A3	A4	A5	A6
Economic factors A1						
Financial and accounting criteria A2	X					
Political factors A3	A	A				
Promotion of the private sector A4	X	O	A			
Government performance A5	V	V	V	O		
Cultural and Public Dimensions A6	V	V	V	O	A	

Source: Research finding.

Table 9. The Reachability matrix of the privatization components with emphasis on financial and non-financial factors

	A1	A2	A3	A4	A5	A6
Economic factors A1	0.00	1.00	1.00	1.00	0.00	0.00
Financial and accounting criteria A2	1.00	0.00	1.00	1.00	0.00	0.00
Political factors A3	1.00	0.00	0.00	1.00	0.00	0.00
Promotion of the private sector A4	1.00	1.00	1.00	0.00	0.00	0.00
Government performance A5	1.00	1.00	1.00	1.00	0.00	1.00
Cultural and Public Dimensions A6	1.00	1.00	1.00	1.00	0.00	0.00

Source: Research finding.

4.6 Drawing the influence-dependence power diagram

In the ISM model, the interrelationships and influence between criteria, as well as the relationship of criteria at different levels, are clearly depicted. This aids managers in gaining a better understanding of the decision-making environment. To identify key criteria of influence and dependence, these criteria are organized into a final access matrix, which is utilized in Mic Mac analysis.

To determine the relationships and hierarchy of criteria in the ISM interpretive structural model, the outputs and inputs for each criterion must be extracted from the matrix. Once

the achievement set and prerequisite set are identified, the intersection of these two sets is calculated. The first variable where this intersection equals the achievable set (outputs) will be considered the first level, indicating the elements with the most influence on the model.

After identifying the first-level indicators, these elements are removed, and the process of calculating the achievement and prerequisite sets continues. This process is repeated until all indicators have been removed.

Table 10. influence-dependence of privatization components, with emphasis on financial and non-financial factors.

	Set ahead	Set back	Subscription	Level
A1	1,2,3,4	1,2,3,4,5	1,2,3,4	2
A2	1,2,3,4	1,2,4,5	1,2,4	2

	Set ahead	Set back	Subscription	Level
A3	1,3,4	1,2,3,4,5	1,3,4	1
A4	1,2,3,4	1,2,3,4,5	1,2,3	2
A5	1,2,3,4,5	5	5	3
A6	1,2,3,4,6	5	5	3

Source: Research finding.

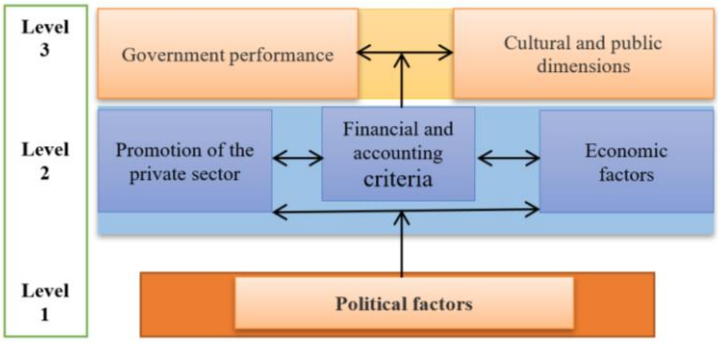
5. Conclusion

Based on theoretical foundations and data collected from experts in privatization organizations, as well as investigations conducted on a paired comparison questionnaire of examined criteria, the results indicate that political factors, with a value of 0.226, are the top priority among privatization components and require more attention according to expert opinion. Following political factors, economic factors rank second with a value of 0.202, cultural and public dimensions rank third with a value of 0.191, financial and accounting criteria rank fourth with a value of 0.171, promotion of the private sector ranks fifth with a value of 0.119, and government performance ranks sixth with a value of 0.084. The prioritization of privatization components, focusing on financial and non-financial factors, also shows an acceptable compatibility rate of 0.007. These results align with previous domestic studies by Jandaghi Ardakani et al. (1402), Bonabi Qadim (1402), Larabi et al. (2019), and foreign studies by Kaiser et al. (2023), Nuti (2023), Radik et al. (2021), Barut et al. (2023), Liahmad et al. (2021), Furlanetto et al. (2019).

Through interpretive structural analysis and reanalysis of research findings, a model is proposed

with three levels as a model of privatization components emphasizing financial and non-financial factors. Political factors are placed at the highest level, followed by economic factors, financial and accounting criteria, and promotion of the private sector at the second level, and government performance and cultural and public dimensions at the third level. This model differs from hierarchical analysis as it aims to find the optimal model of a subject, whereas hierarchical analysis determines the priority of criteria. These results have the potential to influence decisions in the private sector, improving efficiency and prompting changes in decision-making practices for privatization sector managers.

Table 11. The final model of privatization components, with emphasis on financial and non-financial factors



Source: Research finding.

6. Recommendations and suggestions for future research

Based on the findings of the present study, the following recommendations for future research are outlined:

- Identification and prioritization of factors that contribute to successful privatization
- Determination of the necessary infrastructure for facilitating privatization development
- Identification and prioritization of strategies to enhance the efficiency of infrastructure processes in privatization development
- Exploration of the ideal balance between privatization processes and the government's social responsibilities
- Development of a customized model for implementing effective privatization solutions at the local level
- Examination of the components of privatization, with a focus on financial and non-financial factors, utilizing qualitative research methods.

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