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In the Name of God, the Compassionate, the Merciful

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Editor's Note

I am pleased to announce that the Ferdowsi University of Mashhad is publishing Iranian Journal of Accounting, Auditing & Finance (IJAAF). On behalf of the board of the IJAAF and my co-editors, I am glad to present the Volume 1, Issue 1 of the journal in December 2017; the journal will publish four issues in a year. The board includes experts in the fields of accounting, finance and auditing, all of whom have proven track records of achievement in their respective disciplines. Covering various fields of accounting, *IJAAF* publishes research papers, review papers and practitioner oriented articles that address significant issues as well as those that focus on Asia in particular. Coverage includes but is not limited to:

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Yours faithfully,
Mahdi Moradi
Editor in Chief

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Quarterly

RESEARCH ARTICLE

Audit Quality and Income Smoothing Among Listed Deposit Money Banks in Nigeria

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Abstract

The study examined how audit quality impacted income smoothing practices among listed Nigerian deposit money banks (DMBs). While audit quality (AQ) was represented by audit fees (AF), audit firm size (AFS), and audit tenure (AT), income smoothing (IS) was represented by binary variables obtained from the Eckel index of income smoothing. Data were obtained from eleven (11) listed banks from 2013 to 2021. Binary logistic regression was employed. The results indicated that AF is positively associated with IS. In addition, the impact of AFS represented by Big 4 on income smoothing was negative, while that of audit tenure was positive but not significant. The results were similar when the accrual measure of income smoothing was used. The study concluded that the quality of audits determines the tendency for income smoothing among Nigerian listed banks. Therefore, regulators and the management of listed DMBs in Nigeria should emphasize and employ the services of large, reputable audit firms (BIG 4), as it appears to be negatively related to income smoothing. In addition, auditors should be well remunerated to ensure that they exert significant effort to mitigate the incidence of income smoothing.

Keywords:
Firm Value, Financial Leverage, Hybrid Asymmetric Conditional Variance, Return volatility, Size

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1. Introduction

Income smoothing (IS) practices are prominent in developing countries, understandably due to the nature and structure of their economies. Developing countries largely rely on the primary products as revenue sources, making their economies susceptible to external economic shocks. The instability in the country's macroeconomic environment in terms of revenue generation in turn leads to fluctuations in the corporate firms' earnings. In a bid to build the confidence of the investors and creditors and in some cases, satisfy their own bonus plan, management of corporate firms in developing countries engage in earnings smoothing. Paramita (2017), cited in Thoharo et al. (2021), stated that managers focus more on stable earnings because investors prefer it. Studies show that IS does not only help an enterprise beautify the appearance of its financial report but also reduces investors' concern about the enterprise's financial distress (Baik et al., 2020; Park, 2016).

Though the prevalence of IS in developing countries is not illegal and can bring short-term gain to the firms, there is consensus that such practices may threaten the long-term growth and survival of the firms as the consequences of the earnings manipulation in the short term rear it is head (Chang et al., 2021). In line with this, many studies have attributed the failures of several corporate firms to earnings management practices, which is one of the techniques of income smoothing (Dickson, 2021; Susanto and Pradipta, 2019). Hence, it is necessary to mitigate income smoothing practices since they are mainly opportunistic in developing countries. Research efforts have thus been committed to understanding the factors that determine IS among corporate firms.

The different corporate governance failures reported among prominent Nigerian corporate firms like Lever Brothers, Cadbury, Intercontinental and Oceanic Bank (Okaro and Okafor, 2013) have resulted in poor financial performance and the firm's internal ability to maximize the wealth of the stockholder's wealth. These corporate failures have been attributed to using accounting discretion in the form of income smoothing (Dickson, 2021; El Deeb and Ramadan, 2020). It was argued that manipulating corporate earnings to hide the market's reality contributed to most Nigerian entities' collapse (Okaro and Okafor, 2013). Hence, stemming the tide of corporate failures in Nigeria requires adequate control of income smoothing practices as demonstrated in Dickson (2021).

One of the factors that has emerged in corporate finance and accounting literature is AQ. Since income smoothing practices are one of the ways through which the management deceives the shareholders and creditors to achieve a predetermined objective, agency theory suggests that income smoothing creates agency problems and one of the ways of reducing the ability of the management to engage in the practice is efficient monitoring (Alhadab and Clacher, 2018; Demerjian et al., 2020). A quality audit provided by a quality auditing firm is expected to facilitate efficient monitoring of the management against income smoothing practices. It has been reported that using Big 4 audit firms leads to efficient corporate activity monitoring, resulting in lower managerial opportunistic behavior (Alzoubi, 2018; Thu and Khuong, 2020; Yasser and Soliman, 2018). Also, it was reported that aside from the use of the Big 4, AQ is also reflected by the audit firm's independence, which is usually measured using AT (Piot and Janin, 2005). Accordingly, the literature posited that using independent audit firms to rotate the audit firm results in lower managerial ability to engage in opportunistic behaviour such as IS (Susanto and Pradipta, 2019).

Empirically, studies have examined how AQ influences income smoothing practices (Chang et al., 2021; Holinata and Yanti, 2020). These studies have produced mixed results and largely focused on developed markets. However, such a study in Nigeria is very scanty, suggesting that studying the income smoothing practices related to Nigeria's AQ is imperative.

Specifically, the study addressed the following research questions: how does the size of the auditor impact income smoothing among Nigerian listed DMBs? How do AF influence the income

smoothing practice among Nigerian listed DMBs? In what way does the tenure of the auditor affect income smoothing among Nigerian listed DMBs?

Given the foregoing, the study's objectives are to examine the impact of auditor size on income smoothing among Nigerian listed DMBs, investigate the influence of AF on income smoothing among Nigerian listed DMBs, and ascertain how AT affects income smoothing among Nigerian listed DMBs.

The choice of the banking sector is hinged on the prevalence of corporate failures among Nigerian banks in the last two decades and the consequences of the systemic crises that the collapse of the banking sector can have on the nation's economy.

2. Prior studies

2.1 Concept of income smoothing

Several definitions of income smoothing (IS) have emerged in the literature. One such definition is Walker (2013), which describes IS as using administrative discretion to modify how reported underlying economic events are reflected in one or more earnings measures while abiding with the extant accounting principles. Because both are based on the agency theory approach, income smoothing and earnings management are closely related. Bora and Saha (2016) defined IS as an intentional move by managers to reduce profit volatility by employing special accounting procedures. One of the most common ways of creative accounting is income smoothing (Saeidi, 2012). The term IS is another form of managerial discretion that allows managers to normalize their earnings movement and, as a result, affect the risk perceptions of their stakeholders (Walker, 2013). According to several studies (Chang et al., 2021; Kustono et al., 2021; Megarani et al., 2019; Park, 2016), the primary reason managers smooth income is to make earnings less volatile since market participants including creditors and investors, see more smooth earnings path to be less risky.

There have been several attempts to conceive AQ. None of them, however, has resulted in a universally accepted definition. Most academics cite DeAngelo's (1981) definition of AQ, which described AQ as a joint market-assessed tendency that a client's financial record violation will be identified and disclosed by the audit firm. According to Palmrose (1988), a financial report devoid of substantial misstatement demonstrates AQ. According to Chinedu and Chidoziem (2017), an audit with higher quality raises the likelihood that the account report actually reflects the organization being audited in terms of financial and operational status. Rusmin (2010) posits that higher and higher quality audits are expected to raise the accuracy of financial statement information and improve the precision of investors' estimates of a company's value. AQ is measured in studies using factors such as fees (Khalil, 2022), tenure (Gul et al., 2009), and firm size (Alzoubi, 2018).

2.2 Theoretical framework

The study recognizes several theories exist to explain AQ and income smoothing. However, agency theory would be the guiding theory here. Agency theory explains the conflict of interest between management and stockholders, who are known to be self-interested. This approach stops executives from enriching themselves at the stockholder's expense. Jensen and Meckling (2019) identified the audit function as a crucial mechanism in corporations that is indispensable in monitoring the managers' actions to ensure managers' and shareholders' interests are aligned. As a result, AQ is expected to act as a monitoring tool, assisting in deterring managers from manipulating earnings, including income smoothing.

2.3 Audit firm size and income smoothing

The size of the audit firm was defined by DeAngelo (1981) as the natural log of the audit firm's total revenue, the auditors' level of education, job experience, and professionalism. Previous research has shown a link between AQ as measured by a Big 4 auditor's measurement of proxy accounting manipulation (Alzoubi, 2018; Lawrence et al., 2011). Lawrence et al. (2011) have submitted that bigger auditors produce superior and higher quality financial reports compared to those audited by smaller firms. As a result, DeAngelo (1981) theorizes that bigger auditor will produce better audit reports to preserve their reputational asset. The other justification for the higher tendency of Big 4 auditors to produce quality reports is that they have the resources needed to attract highly trained and skillful personnel (Lawrence et al., 2011). Hence, BIG4 is a quality-of-auditor indicator set to 1 if the company has a Big-4 auditor and 0 if not.

In terms of empirical evidence, Ozili (2022) revealed in a study based on data collected from selected Banks in 21 African countries between 2002 and 2014 to investigate how big4 audit firms affect African banks' earnings management from loan loss provision during a crisis. The fixed effect panel regression results for the study's objectives indicate that banks audited by big-4 firms are income smoother in the pre-and during-the-financial crisis but not after the financial crisis. They concluded that AQ improved the firm's earnings quality.

Using data generated from a total of 42 Egyptian firms covering 2015 to 2017, EL Deeb and Ramadan (2020) reported from panel regression analysis with earnings management measured with accrual model discretionary component that AQ significantly impacts earnings management practices. Ajekwe and Ibiamke (2017) reported in a study of the Nigerian real sector that AFS lowers earnings management but is not significant. Tyokoso and Tsegba (2015) reported in a study based on oil marketing firms in Nigeria that auditor size does not significantly impact discretionary accrual. Aliyu et al. (2015) reported in a study using data from Nigerian Banks that AFS significantly lowers the incidence of earnings management.

2.4 Audit fees and income smoothing

AF encompass the total remuneration the auditor receives from the client firms for the audit activities carried out by the audit firm. This is usually stated as the auditor's remuneration in the annual report. Prior research suggests that paying a company's external auditor a large audit fee strengthens its economic links, thereby jeopardizing the auditor's independence (Chang et al., 2021). Independence entails being free of inspiration, stimulus, or guidance, and the audit function's usefulness will be severely harmed if independence is not achieved. Auditor risk has been perceived as non-objective when its independence is doubtful, suggesting that the auditor may not report the bridge of reporting procedure by the firmitor. This means that if a breach is identified, the auditor is unlikely to report it. The decreased independence leads to lower AQ and more EPS manipulation. Empirical evidence exists on the link between AF and income smoothing, among which is Khalil (2021), who reported in a study of selected banks in the Banking Industry of Pakistan using the Modified Jones accrual model that higher AQ is associated with lower AF in Pakistan banking sector. Chang et al. (2021) equally found in a study of 12 823 US firms that AF had a lower income smoothing tendency. Aliyu et al. (2015) reported in a study using data from Nigerian Banks that financial dependence on audit firms increases the tendency of earnings management, suggesting that higher fees may encourage auditor discretionary reporting.

2.5 Auditor tenure and income smoothing

The correlation of auditor tenure and AQ may be anchored on two points of view. The first, backed by the proposition that auditors acquire more and better knowledge about the firm operation when they spend longer terms with the firm, is that tenure increases the quality of accounting reports and

lowers income smoothing by extension. Previous evidence affirms management's reduction in discretionary accrual when the auditor spends longer term with the client firm (Gul et al., 2009; Myers et al., 2004). A continuously appointed auditor is expected to better know the firm's operations and internal control framework. The auditor uses this to create audit methods, which results in a higher-quality audit. In combination with the earnings response coefficient, a longer audit duration implies a greater earnings quality (Ghosh and Moon, 2005). The second viewpoint, baked by the proposition that an auditor will become less independent when engaged for a longer term, is that longer tenure encourages discretionary practices such as income smoothing. A longer tenure can jeopardize an auditor's independence due to a closer client-auditor relationship, leading to a rise in income smoothing (Abedalqader Al-Thuneibat et al., 2011). According to Davis et al. (1993), AQ declines as tenure increases since the client has more financial reporting freedom as the AT increases. Jayeola et al. (2017) reported that earnings management is not sensitive to audit firm tenure in a study of Nigerian Banks. Tyokoso and Tsegba (2015) reported in a study based on oil marketing firms in Nigeria that auditor tenure is negatively associated with discretionary accrual.

3. Research methodology

3.1 Data and method of analysis

This study employs a longitudinal or panel research design. This becomes imperative due to the scope of the study and the nature of the data to be collected, which is characterized by the unit (firms) and time (year covered) dimensions. The study used data collected from 11 DMBs out of the 14 listed on the Nigerian Exchange group between 2013 and 2020. These banks are selected using purposive sampling as the banks whose information on all variables is available to make up the study sample.

Since the measure of income smoothing used in the study is based on the Eckel (1981) model, a binary variable for the firm practicing income smoothing and those who do not, the analysis method employed is binary logistic regression. This method is the most suitable for achieving the study's objective if this measure of income smoothing is employed. A similar approach was used by Thu and Khuong (2017).

In addition, the study conducted diagnostic tests to validate the results obtained. Among the post-estimation diagnostic tests conducted are the multicollinearity test using Variance Inflation Factor (VIF), serial correlation test using the Wooldridge test for serial correlation in panel data and heteroscedasticity test using modified Wald test for group-wise heteroscedasticity.

3.2 Model Specification

The study examines the influence of AQ, represented by AFS, audit fees, and AT, on income smoothing practice. Both theoretical and empirical literature suggests that income smoothing practices are closely linked with AQ and client firm attributes, including financial leverage and firm age. Due to the nature of the study's dependent variable, which is divided into income smoother and non-income smoother, panel binary logistic regression is the most appropriate for the study. Hence, the binary logit model for achieving the study's objectives is expressed as:

$$ICS = f(AFSZ, AUDF, TEN, AGE, \text{LEV}) \quad (1)$$

The logistic panel specification of equation 1 is given as

$$\log\left(\frac{pr(ICS_2)}{1-pr(ICS_2)}\right) = \vartheta_0 + \vartheta_1 AFSZ_{it} + \vartheta_2 AUDF_{it} + \vartheta_3 TEN + \vartheta_4 AGE_{it} + \vartheta_5 LEV_{it} + \mu_{it} \quad (2)$$

The equation in 2 above implies that the probability of being income smoother $pr(ICS_2)$ is expressed as:

$$\Pr\left(ICS_2 = {}^{1}/_{AFSZ, AUDF, TEN_{it}, X_{it}}\right) = \frac{e^{\vartheta_0+\vartheta_1 AFSZ_{it}+\vartheta_2 AUDF_{it}+\vartheta_3 TEN+\vartheta_4 AGE_{it}+\vartheta_5 LEV_{it}+\mu_{it}}}{1+e^{\vartheta_0+\vartheta_1 AFSZ_{it}+\vartheta_2 AUDF_{it}+\vartheta_3 TEN+\vartheta_4 AGE_{it}+\vartheta_5 LEV_{it}+\mu_{it}}} \quad (3)$$

Where X_{it} denotes the vector of control variables.

The apriori expectations are summarized as thus

$\vartheta_1, \vartheta_2 < 0$; $\vartheta_3, \vartheta_4, \vartheta_5 > 0$

3.3 Measurement of variables

The study measures income smoothing using the binary variable obtained from the Eckel Index where 1 is assigned if a firm is found to be income smoother and 0 is assigned otherwise. The Eckel Index is obtained using the procedures below in line with Eckel (1981):

$$\text{Eckel Index} = \frac{CV\Delta I}{CV\Delta S} \quad (4)$$

$$CV\Delta I = \frac{\sum(\Delta I - \Delta\bar{I})}{n-1} \quad (5)$$

$$CV\Delta S = \frac{\sum(\Delta S - \Delta\bar{S})}{n-1} \quad (6)$$

Where:

ΔS = Change in sales

ΔI = change in profit; $\Delta\bar{I}$ = average change in profit; $\Delta\bar{S}$ = average change in sale

CV = coefficient of variation; n= number of years covered

From the Eckel Index obtained, a firm is classified as income smoother if it has an Eckel Index of less than 1 such that $CV\Delta S > CV\Delta I$. On the other hand, a firm is classified as a non-income smother if it has an Eckel Index greater than 1 such that $CV\Delta S < CV\Delta I$.

The study's independent variable is AQ, proxy by size, tenure and fees paid for auditing in line with previous related literature (Chang et al., 2021). The size is measured using binary indicators 0 and 1, in which a firm is assigned 1 if audited by a Big 4 firm while 0 is assigned otherwise. The fees are measured as the log of the auditor remuneration for each year, while the audit firm tenure is measured as the total years an audit firm is consistently engaged. Following related literature (Akhoondnejad et al., 2013; Indrawan et al., 2018), the study includes two control variables in the income smoothing model. They include financial leverage and the bank's age. While the bank's age is measured in terms of the number of years since the firm was listed on the stock exchange, financial leverage is measured as the ratio of total debt to equity expressed in percentage.

4. Results and discussion

The results of the description in Table (1) revealed that the average income was somewhat 0.805, implying that income smoothing is recorded in about 80.5 percent of the observation. The second measure of income smoothing used in the study based on the accrual model is found to be 0.014 on average, with a standard deviation of 0.013. The results further show the average log of AF for the

banking sector in Nigeria to be 19.475 with a standard deviation (SD) of 0.753, suggesting moderate variation in the AF of the sampled banks. Also, the AFS is 0.844, implying that 84.4 percent of the study's observations are audited by the Big 4. At the same time, the estimated results suggest that the average tenure of the audit firms in the banking sector of Nigeria is 5.455, with a minimum AT of 1 and a maximum of 10 years. In addition, the average financial leverage for the sampled period is 6.175, indicating that the total debt to equity ratio of Nigerian DMBs is 6.175 percent. The estimated average firm age is found to be 24.364.

Table 1. Descriptive statistics of variables

Variable	Obsn	Mean	Stnd.Devt.	Minm	Maxm
ICS1*	120	0.805	0.399	0.000	1.000
ICS2*	120	0.014	0.013	0.000	0.072
AUDFL	120	19.475	0.753	18.133	20.732
AFSZ	120	0.844	0.365	0.000	1.000
AUDT	120	5.455	2.404	1.000	10.000
AGE	120	24.364	13.649	8.000	49.000
LEV	120	6.175	2.641	-2.051	13.307

Source: Author's Computation, 2022

Note: ICS1 is a binary measure of income smoothing obtained from the Eckel Index; ICS2 is the accrual-based measure obtained using the Modified Jones Accrual model.

Results of the correlation in Table (2) suggest that AF with an estimated correlation coefficient of 0.342 are positively associated with income smoothing. The AFS was also found to exert a positive relationship with IS among the sampled banks, with a correlation coefficient (CI) of 0.060. In contrast, the relationship between AT and income smoothing was positive. The estimated CI of 0.176 similarly implies that AFT is positively associated with the IS. Also, the estimated CI of 0.231 indicates that firm age is positively associated with IS while financial leverage with a correlation coefficient of 0.0001 is equally positively related with income smoothing.

Table 2. Estimated matrix of correlations

Variable	INCSMT	AUDFL	AFSZ	AUDT	AGE	LEV
INCSMT	1.000					
AUDFL	0.342***	1.000				
AFSZ	0.060	0.534***	1.000			
AUDT	0.176	0.142	0.172	1.000		
AGE	0.231**	0.287**	0.423***	0.119	1.000	
LEV	0.0001	0.293***	0.184*	0.093	0.204*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Source: Author's Computation, 2023

4.1 Diagnostic tests

The study conducted diagnostic tests for multicollinearity, heteroscedasticity and serial correlation, as shown in Table (3). The results of the variance inflation factors revealed a highest VIF of 1.589 with a mean VIF of 1.296. The implication is that the results obtained from the study are free of multicollinearity problems since none of the VIF estimated is up to the threshold of 10. The results of the Breusch-Pagan test for heteroscedasticity show a heteroscedasticity problem in the data used for the study, given the Breusch-Pagan p-value of 0.0002. Also, the Wooldridge test results suggest that the data used in the study are characterized by first-order serial correlation with a Wooldridge p-value of 0.0427. Hence, the study adjusts for this violation by obtaining the regression

with robust standard error.

Table 3. Summary of diagnostic test results

Test	Results
Variance Inflation Factors for Multicollinearity	Highest VIF = 1.589 Mean VIF = 1.296
Breusch-Pagan test for heteroskedasticity	Chi2 = 13.910 Prob > Chi2 = 0.000
Wooldridge test for serial correlation	F stat = 5.385 Prob > Chi2 = 0.042

Source: Author's Computation, 2022

4.2 Binary logistic panel regression results

The results obtained from the binary logistic panel regression for AQ on income smoothing are presented in Table (4). From the results, an audit fee with an estimated coefficient of -2.111 and p-value of 0.003 exerts a negative and significant influence on IS. This suggests that the probability of being income smoother is lower when a higher fee is paid to the audit firm by the listed Nigerian DMBs. The logistic panel regression results in Table (4) revealed that auditor size's impact on IS is negative and significant at a 5 per cent level with an estimated coefficient and p-value of -2.617 and 0.026, respectively, implying engaging Big 4 audit firm lowers the tendency for income smoothing practice. In addition, the estimated coefficient of 0.127 and corresponding p-value of 0.420 in the results of the binary logistic regression in Table (4) indicate that AT exerts a positive influence on income smoothing practice among Nigerian listed DMBs, though the impact is not significant at all conventional levels.

Table 4. Estimated Binary Logit Regression results of the study (Dependent = Income Smoothing)

INCSMT	Coeft.	Stnd.Err.	t-value	p-value	[95% Confd	Interv]	Sign
AUDFL	-2.23	0.568	-3.930	0.000	-3.342	-1.117	***
AFSZ	-3.014	0.602	-5.000	0.000	-4.195	-1.833	***
AUDT	0.047	0.198	0.240	0.812	-0.340	0.435	
lAge	2.158	0.518	4.170	0.000	1.143	3.172	***
lev	0.894	0.192	4.650	0.000	0.518	1.271	***
Constant	-46.331	10.858	-4.270	0.000	-67.613	-25.049	***

Mean dep variable	0.805	Stnd dep variable	0.399
No of Ob	120	Chi-square	11.319
Probl > chi2	0.045	Akaike critr. (AIC)	70.501

*** *p<.01*, ** *p<.05*, * *p<.1*

Source: Author's Computation,

It is equally revealed that firm age positively and significantly impacts the IS of listed Nigerian DMBs at a 10 per cent level (coeff = 0.086; p val = 0.064). The implication here is that older firms tend to engage in IS. However, the impact of financial leverage on IS was found to be negative and insignificant, suggesting that financial leverage does not matter for income smoothing among Nigerian listed DMBs.

4.3 Robustness check

In Table (5) Robustness is carried out using an accrual measure of income smoothing as in the

previous related study (Abogun et al., 2021) and the results were obtained with a random effect (RE) panel given that the p-value of the Chow test is rejected while the Hausman p-value could not be rejected. From the results, audit fees maintain a significant negative influence on income smoothing (coeft =-0.006: p-value =0.004), which is in agreement with the results obtained using the Eckel Index measure of IS. Similarly, the results obtained with respect to the influence of AFS indicate that engaging the Big 4 lowers the tendency of smoothing income (coeft =-0.004: p-value =0.207). Still, such impact is not significant at 5%. In addition, the results obtained indicate that engaging the same audit firm for a longer period encourages income smoothing (coeft =0.004: p-value =0.038).

Table 5. Estimated random effect panel regression results of the study

ICS2	Coeft.	Stnd.Err.	t-value	p-value	[95% Confd	Interv]	Sign
AUDFL	-0.006	0.002	-2.850	0.004	0.010	0.002	***
AFSZ	-0.004	0.003	-1.260	0.207	-0.010	0.002	
AUDT	0.004	0.002	2.070	0.038	0.000	0.009	**
LAge	0.007	0.002	2.860	0.004	0.002	0.012	***
Lev	-0.002	0.005	-0.440	0.657	-0.013	0.008	
Constant	0.105	0.038	2.800	0.005	0.032	0.179	***

Mean dep varbl	0.014	Stnd Devt dep var	0.013
Overall r-sqrd	0.326	Number of obs	120
Chi-square	25.231	Prob > chi2	0.000
R-sqrd within	0.461	R-sqrd between	0.721
Chow F-test	1.930	Prob of Chow F	0.043
Hausman F	1.150	Prob of Hausman F	0.949

*** $p<.01$, ** $p<.05$, * $p<.1$

Source: Researcher's Computation, 2023

5. Discussion of findings

The study found a negative and significant influence of AF on IS among Nigerian listed DMBs. The implication of these results is that payment of higher AF is associated with a lower tendency for income smoothing practices in agreement with the expectation that higher fees should promote AQ through higher audit effort and thus lower income smoothing contained in the theory of audit effort. This result contradicts the theory of economic bonding, where higher AF increase the bond between the audit firm and the client firm, which harms their independence. The audit firm tends to look away when management engages in income smoothing in the face of higher bonding brought by higher AF. The findings agree with the submission of many other related empirical literature, including Khalil (2021) in Pakistan, where lower AF increase the quality of financial reports and lower IS. The findings equally agree with the report by some related literature, including that of Chang et al. (2021), who reported that AF is negatively associated with IS in a study of US companies.

Furthermore, the analysis revealed that AFS significantly negatively impacts income smoothing practices among Nigerian listed DMBs. The results imply that engagement of Big 4 audit firms lowers the tendency of the Nigerian listed DMBs. The results here align with the expectation of the study and corroborate the submission of the agency theory where hiring a quality audit firm increases the audit firm's monitoring capacity, especially to detect opportunistic behavior on the part of the

management, including income smoothing practice. Therefore, the finding here, as related to AFS, reinforces the proposition of the agency theory that AFS tends to lower agency conflict. Similar empirical literature has reported that AFS is associated with lower opportunistic behavior tendencies, including income smoothing practices, which are the findings of Sumiadji et al. (2019) in a study of Indonesian firms and Aliyu et al. (2015) in a study of Nigerian DMBs. The study is, however not in agreement with the report of Ozili (2022) that Big 4 audited firms engage in income smoothing and Ajekwe and Ibiamke (2017) and Tyokoso and Tsegba (2015) who found in a study of the Nigerian real sector and oil and gas firms respectively that earnings AFS does not affect smoothing practice.

In addition, the study found through the binary logit panel regression analysis that AT had a positive but insignificant influence on income smoothing among Nigerian listed DMBs. By implication, the non-rotation of audit firms does not matter for income smoothing practices among Nigerian listed DMBs. The results found here are variant from the submission in other related empirical literature, which found that longer tenure impairs an audit firm's independence and increases the tendency for income smoothing. Among these studies are Ajekwe and Ibiamke (2017), who reported that audit firm independence indicated by AT lowers earnings manipulation. However, in agreement with the findings of this study, very few other studies have documented no impact of audit firm tenure on management opportunistic behavior, including income smoothing. These studies include that of Jayeola et al. (2017) in a study on Nigerian DMBs between 2005 and 2014.

6. Conclusion and recommendations

The study was set up to investigate the implication of AQ on income smoothing practices among Nigerian listed DMBs. The binary logistic regression results employed in the study revealed that AF increases the tendency for income smoothing practices, implying that firms that pay higher AF to the audit firms have a higher probability of being income smoother. The same results are obtained using accrual income smoothing measure as indicated in the random effect panel regression. The results regarding the impact of AFS revealed that the impact of auditor size on IS is negative and significant, suggesting that the tendency for income smoothing lowers when a Big 4 audit firm is engaged. On the contrary, the impact of audit firm tenure on IS is found to be positive but not significant. By implication, the study found that AQ drives income smoothing practices among listed Nigerian DMBs. However, the roles played by different AQ indicators differ as AF encourage income smoothing while AFS lowers the tendency for income smoothing. The findings here affirm the proposition of agency theory in corporate finance literature where quality audit raises the monitoring of management practices, resulting in lower income smoothing practices. In line with the findings here, the study's recommendations include that the regulators and the management of Nigerian listed DMBs should emphasize and employ the services of large reputable audit firms (BIG 4) as it appears to be negatively related to income smoothing. In addition, the relevant stakeholders should come up with a framework that would regulate the AF paid to the audit firm in a way that will reduce the ability of the audit firm to compromise the detection of management opportunistic behavior due to higher AF they receive.

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Operational Use, Responsibility and Performance Measurement

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Abstract

Today, the performance measurement system (PMS) is critical in organizational activities to improve performance. Thus, this study aims to examine the operational use of PMS in Mashhad Municipality further. To achieve this, research data were collected through a questionnaire, and research hypotheses were tested using structural equation modeling and Smart PLS3 software. The results of the first hypothesis indicate that the operational use of PMSs positively and significantly impacts performance. Additionally, the results of testing the second hypothesis demonstrate that operational use positively and significantly affects organizational responsibility. However, the third hypothesis did not confirm the mediating role of responsibility in the relationship between operational use and performance. These findings offer organizations an opportunity to consider the identification and prioritization of performance indicators during the design phase of PMSs. It is worth noting that no previous research has focused on the role of PMS and investigated this relationship.

Keywords:
Operational Use,
Performance Measurement,
Responsibility

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1. Introduction

In order to survive in the competitive environment, the organization must be aware of the factors that affect organizational performance and take steps to improve them. Furthermore, organizational responsibility is a key indicator of an organization's superiority, providing the foundation for growth and development. It is also important for the organization to recognize the need for an optimal PMS to gauge the extent to which its goals and strategies are being realized. Managers of the organization are well aware of the significance of this fact. Achieving this optimization requires continuous monitoring, establishing performance measurement criteria, and prioritizing these criteria (Berkelman and Le Duc, 2014).

Today, the PMS plays a vital role in organizations as a management tool to accomplish organizational strategies and predetermined goals. Without a doubt, the outcomes of this system significantly impact the decision-making of both public and private sector managers. It also provides valuable information regarding the current state of the organization and its proximity to the desired level for internal stakeholders and even external shareholders. In essence, the system's output serves as the organization's executive arm of strategic management. Furthermore, the feedback from this system serves as the primary tool for enhancing organizational productivity and promoting the organization's policies (Saadat, 2015). Ultimately, the establishment of a PMS aims to improve accountability. The output components of the PMS consist of performance feedback, which enhances internal performance and ensures transparency in external performance. This serves as a means to enhance the organization's transparency on a global scale (Pourreza and Moulai, 2019).

The significance of performance measurement arises from the mechanisms for achieving organizational goals relying on management efficiency. It is crucial in effective management, continuous control, and monitoring. To achieve efficient management, it is essential to implement a PMS with the objective of accountability. As crucial participants in urban management, municipalities hold key accountability in implementing a system for monitoring and measuring process performance. This helps to identify and strengthen the organization's weaknesses and respond to society's needs (Shieh, 2003).

2. Literature review

The control mechanism is part of the organizational structure. It checks whether the organizational goals are consistent with the ongoing plans. This process compares the actual performance with the expected standards or goals. Finally, according to the system feedback, corrective actions are taken (Tessier and Otley, 2012).

In this paper, we emphasize the dual role of controls, which refers to the distinction between facilitating and influencing the decision in PMSs (Ahrens and Chapman, 2004). The influencing role of the decision refers to using information to motivate and control managers and employees (incentive-oriented use). In contrast, the facilitating role emphasizes providing information to guide decision-making and managerial actions (Grafton et al., 2010). In this research, we follow Hansen and Van der Stede's (2004) focus on the role of decision facilitator and distinguish between single-loop learning (operational use) and double-loop learning (exploratory use). Given that the scope of this research focuses on the operational use of PMSs, we have omitted the description of other roles.

2.1 Performance

Organizational performance relates to the actions and activities undertaken by an organization to achieve its goals. Additionally, the performance measurement within the organization determines the extent to which these goals are accomplished (Hoffer, 2017).

Organizational performance is interpreted as an extensive concept. The most comprehensive concept can be considered as the set of activities of the organization to achieve organizational goals. For this reason, the extent to which an organization reaches its goals highlights the need to measure and evaluate performance (Hamidizadeh et al., 2016). Typically, managers are personally responsible for the actions taken to achieve goals. However, they also possess the ability to prevent deviations within their organizational units. This is crucial because distortions can hinder the achievement of performance goals and contradict performance enhancement (Feltham and Xie, 1994).

On the other hand, there is no universally accepted definition or criteria for organizational performance due to its multidimensional nature. Aside from financial and quantitative indicators, organizational performance can be assessed using commitment, productivity, quality, efficiency, and customer satisfaction indicators. Generally, performance encompasses both quantitative and qualitative aspects. This research focuses on qualitative performance, including concepts like achieving service and efficiency goals, maintaining accurate and high-quality work, providing a certain number of services, and ensuring efficiency within the organizational unit, as Speklé and Verbeeten (2014) proposed.

When organizational performance aligns with specific requirements such as organizational goals, it enables quick identification of many issues the organization faces. This level of alignment necessitates a robust control system to identify weaknesses and offer practical solutions. Therefore, an organization that prioritizes performance management systems and maintains a holistic approach to organizational performance fosters synergy between individuals and the organization (Ghafari, 2018).

A questionnaire developed by Van de Ven and Ferry (1980) has been employed to measure performance in this research. This tool has been specifically designed and utilized by Verbeeten (2008), Speklé and Verbeeten (2014), and Mahmoudi et al. (2021) to assess performance in public sector organizations.

2.2 Performance Measurement System (PMS)

Performance measurement is one of the complex issues. Its concepts are examined in at least three areas: economics, management and accounting. For this reason, to design an efficient PMS, many factors should be considered, such as the purpose of measurement, the time required for measurement, the cost of measurement, the availability of data and the necessary level of detail (Tangen, 2004). According to Fisher (1990), when the PMS or control feedback of deviations can be discussed and measured using numbers, the organization's awareness of progress and continuous improvement becomes significant. Without this measurement, deviations cannot be controlled and managed effectively.

First and foremost, it is important to consider that performance measurement is proposed at both individual and organizational levels within the definition of PMS. The items presented as the output of the performance measurement at the individual level lead to improving the individual performance and determining the reward criteria. This research specifically focuses on organizational performance. The criteria for performance measurement indicators determine the PMS's purpose and type of use; thus, an overview of the PMS is necessary.

A comprehensive definition of performance measurement includes implicit management tools that aim to increase accountability and transparency, improve organizational performance, and enhance efficiency and effectiveness in service provision (Raboca, 2021). The most important goals of measuring performance at the organization level include continuous control of activities, identification of strengths and weaknesses of the organization, efforts to increase capabilities and

improve activities, decision-making, and organizational performance and strength. Finally, productivity in the organization will increase (Haghighi Kafash and Sadeghi, 2008).

Nudurupati (2011) identified four components of PMS in an organization: design (what should be measured), implementation (how the system works), use (how the system is used), and review (what needs to be changed). However, Maestrini et al. (2021) argue that determining the type of PMSs used before designing the system impacts performance.

Tangen (2004) suggests that an optimal PMS should possess several general characteristics. Firstly, it should be aligned with the organization's strategic goals to ensure that it supports activities aligning with its strategies. Additionally, strategies may evolve over time, necessitating the transformation of certain performance measures. Therefore, the system should have the ability for temporal visualization to continuously align the PMS with the company's goals. Secondly, it should achieve a proper balance by covering critical indicators agreed upon as success criteria of the organization with different performance criteria. However, defining balance precisely is challenging as it involves various interdependent dimensions. For instance, it involves balancing short-term and long-term goals, different performance factors such as cost and quality, and perspectives from stakeholders, shareholders, competitors, and the organization at various levels.

Third, a PMS should prevent sub-optimization by selecting appropriate performance criteria that influence employees' behavior positively. Inappropriate criteria can lead to inefficient or unpredictable behavior, as employees may focus on improving their performance in ways that conflict with management's wishes (Fry, 1995). In other words, employees who seek to improve their performance often make decisions contrary to management's wishes. Skinner (1986) called this phenomenon the "productivity paradox", where weak consequences of performance indicators cause inefficient behavior. Therefore, a PMS should protect against sub-optimization by creating a strong connection from the main layers to the sub-layers to ensure that employees' behavior is consistent with the organization's goals.

Fourth, for continuous improvement, it is necessary to use a limited number of performance indicators (Jackson, 2000). More measurements require more analysis time, and unnecessary data wastes time and resources. Therefore, paying attention to the details is important, as is avoiding repetition of required data and evaluating whether the data is necessary for the intended purpose or if the cost of collecting them exceeds the expected benefit (Bernolak, 1997). Conversely, many performance criteria increase the risk of excessive information accumulation and make it challenging to prioritize which performance criteria should be focused on. This is also a valid reason to eliminate outdated activities that are no longer prioritized in the current PMS.

Lastly, accessibility and comprehensibility are essential characteristics of PMSs. The primary goal is to provide relevant information to the appropriate individuals at the right time. Therefore, performance measurement criteria should have a specific purpose, and defining who will use each criterion is necessary. Additionally, setting clear goals and timeframes for achieving those goals for each performance measure is essential (Tangen, 2004).

In the urban management system, measuring performance serves the purpose of reviewing and evaluating performance and delivering public services effectively. Performance indicators encompass the quantity and quality of service effectiveness. By utilizing the information from the PMS, the municipality, as the custodian of urban management, can identify weaknesses, allocate resources and capacities optimally, improve accountability, and ultimately provide high-quality urban services. Decentralization of decisions at lower levels of government institutions involves many organizations. For this reason, municipalities have considerable independence in designing and using their PMSs (Mousavi, 2016).

Previous studies have highlighted various purposes for using PMSs. For example, Franco-Santos

(2007), Hansen and Van der Stede (2004), Simons (1995), and Henri (2006) categorized PMS roles in their research. These roles depend on the classification used to define and operationalize PMSs. In the context of public administration, the focus is often limited to the operational and incentive-oriented roles of PMSs, which are considered the conventional classification of these systems (Cavalluzzo and Ittner, 2004). This research primarily concentrates on the operational use of PMSs.

2.3 Operational use

Performance measurement has become common in many public sector organizations. It has largely replaced the procedural management control that public sector organizations traditionally relied upon. One of the main reasons for this replacement has been to increase efficiency and effectiveness at the service level (Hood, 1995; Bouckaert and Kuhlmann, 2016; Kuhlmann and Heuberger, 2023).

In performance measurement research, a distinction has been made between the design and use of PMSs. The design involves aspects related to performance indicators' types, numbers, and goals. However, decisions about the design of PMSs are often made at higher levels of the organization. Unit managers often decide how to use PMS at lower levels of the organization. Therefore, understanding organizational levels and their relationships is essential (Van Elten, 2021; Van der Kolk, 2022).

Simons (1995) classifies the use of PMSs as interactive or diagnostic, arguing that these different uses work together to manage organizational tensions, such as the tension between creativity and control. Interactive use is seen as exploratory, aiming for organizational learning. Diagnostic use is further divided into operational and incentive-oriented use, which tracks operational efficiency and aligns employee motivation with organizational goals. This classification results in three types of PMS used in the public sector: exploratory use, operational use, and incentive-oriented use (Speklé et al., 2017). Operational use with a managerial approach involves measuring performance for operational planning, budget allocation, and process monitoring (Van Elten, 2021). However, combining diagnostic and interactive approaches significantly impacts performance improvement (Maestrini et al., 2021).

Unlike traditional budgeting, which is unrelated to strategic planning, operational budgeting is used for planning and strategy formation in organizations. Previous research has shown that performance measurement is a key factor in budgeting. However, the organization's approach to aligning budgeting with performance measurement is not consistent. This inconsistency stems from prioritizing budgeting goals (Garrison and Noreen, 2003). In their research, Hansen and Van der Stede (2004) state that budget allocation, operational planning, and process control are common dimensions of operational PMS use across organizations. These dimensions are fundamental regardless of the organization's design and structure. Thus, budget allocation, operational planning, and process control are the main concepts that distinguish operational PMS use from other forms (exploratory use and incentive-oriented use).

In our research, we utilize the three concepts identified by Hansen and Van der Stede (2004) and Speklé and Verbeeten (2014) for operational PMS use, arguing that PMSs in organizations pursue diverse goals. It is this diversity that leads to different uses of the system. Additionally, the type of functional indicators chosen during the system design stage determines the type of system used. In other words, our first hypothesis proposes that the operational use of PMSs, focusing on process control, operational planning, and budget allocation, significantly impacts organizational performance. Thus, the purpose of our research is to investigate the operational use of PMSs and its effect on organizational performance, leading to the formulation of the following hypothesis:

H1: The operational use of PMSs significantly affects organizational performance.

2.4 Responsibility

Expressing a single concept of responsibility among managers is particularly important to develop multi-management systems. A clear and explicit definition of the scope of responsibility provides guidelines for designing management systems by measuring assigned responsibility among various factors (Wooldridge et al., 2000).

Many researchers, including Selznick (1948) and Giddens (1987), have referred to organizational and social theories in their research. As a common opinion, they have raised the issue that the structure of organizations is not unidimensional but rather multidimensional. They have considered at least three power, coordination, and control dimensions for the organizational structure (Fararo, 1997; Sorensen, 1978). These dimensions are related to many organizational unit activities, called organizational activities, which involve managing interrelationships between organizational functions. In other words, they guarantee that activities are carried out organizationally. Delegation of authority, information, and supervision are activities related to the structural dimensions of the organization (Grossi et al., 2007).

Additionally, accountability has a multilateral interaction with organizational structure dimensions (power, coordination, and control) and delegation activity. Therefore, accountability is one of the consequences of responsibility and requires a PMS. However, responsibility at the organizational level has other consequences. People working in an organizational unit may consider each other as the reason for not fulfilling their duties. This is not the sole challenge that responsibility at the organizational level faces. A manager can be responsible for a failure without actually being at fault if they were not informed about the task they were supposed to perform and did not have enough information (Smith, 2015). In support of this, deontology theory states that the correctness of tasks should be measured regardless of their results and consequences (Ten Have and Patrão Neves, 2021). This theory claims that although the consequences of activities cannot be ignored, another feature distinguishes the rightness and wrongness of tasks, and that feature is the scope of tasks (Movahedi, 2009).

To confirm this gap, it is necessary to differentiate the meaning of the concept of responsibility at the organizational level from the individual level. In this research, the organizational level is examined, and the concept of accountability to the beneficiary of the activities performed is one of the reasons for establishing the PMS and the organizational activities. This research considers three dimensions of responsibility: the existence of activities beyond the results of the organizational unit, the alignment of activities with public interests, and the performance of the organizational unit (efficiency and effectiveness) in line with public interests (Grossi et al., 2007).

The section related to operational use defines budget allocation, operational planning, and process control as the three main dimensions of the operational use variable. Ekholm and Wallin (2000) researched the consequences of the annual budget and the goals and reasons for budgeting. According to them, budget allocation is one of the reasons for using the PMS, which leads to the creation of specified tasks in the system. These tasks are defined for organizational units, creating the expectation of responsibility and implementing actions aligned with operational planning. Therefore, in this research, the operational use of PMSs is expected to impact organizational responsibility. Hence, the second hypothesis of the research is proposed as follows:

H2: Operational use affects organizational responsibility.

Generally, each organization has a predetermined operational goal. The operational use section mentioned that if there is a gap in reaching these goals, can the organizational unit be held responsible for implementing the work? In other words, can organizational responsibility mediate the relationship

between the operational use of the PMS and the organization's performance? The third hypothesis of this research is based on the answers to these questions. Therefore, by closely examining what is called organizational activities, the relationship between operational use and organizational performance can be examined in the presence of the responsibility variable. The third hypothesis of the research is stated as follows:

H3: Responsibility has a mediating role in the relationship between operational use and performance.

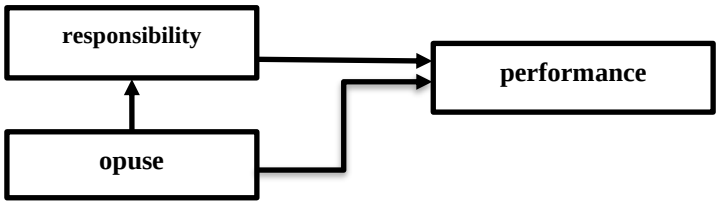

Figure 1. Conceptual framework of research

3. Research methodology

The analysis of the research model has been conducted using structural equation modeling with the partial least squares (PLS) method. Structural equation modeling involves two stages of model analysis. The first stage involves fitting the measurement model (external model) to conduct reliability, validity, and model quality tests. In the second stage, the research hypotheses of the structural model are tested. In this study, the measurement model for each variable is developed and the model's overall fit is assessed using Smart PLS3 software alongside the structural model.

3.1 Statistical population and research sample

Considering that the purpose of the research is to investigate the operational use of PMSs (which is the most common type of use in any organizational unit), an effort has been made to include individuals in the statistical population who are part of the organizational unit and are partially involved in performance measurement. The organizational unit, as an executive entity within a larger organization, is overseen by a manager who has a certain level of authority over the tasks and processes of the unit (Cavalluzzo and Ittner, 2004; Mahmoudi et al., 2021). The reason for selecting the organizational unit as the desired level for collecting information is that criteria for internal PMSs and the organization's responsibilities may vary in larger categories beyond the organization itself. The individuals included in the sampling pool are municipal staff managers, CEOs of organizations, deputy heads of organizations and regions, heads of departments, and experts in the financial and executive fields (with a minimum of 5 years of work experience) in Mashhad Municipality in 2021.

For sampling, the statistical population is first divided into classes, including headquarters (central), regions (14 regions), organizations (e.g., transportation and freight within the city and suburbs, passenger terminals, civil organizations, parks and green spaces), management (program, budget, and performance measurement office, investment and participation, administrative and financial support, etc.), vice-chairs (health and sports, social and cultural organization, tourism and pilgrimage, etc.). The research samples are then selected using simple random sampling. Additionally, Cochran's formula was used to determine the minimum required sample size, and a total of 144 questionnaires were collected.

The data collection tool used a questionnaire based on the Likert scale (5 points). The PMSs were examined in 5 sections: input, process, quantitative output, qualitative output, and result (effect), with 10 specific goals. To determine the use of PMSs, respondents were asked to indicate the extent to

which they use performance measures according to the goals. These goals include input criteria (cost ceiling, budget realization, prohibition of changing cost classes), process criteria (capacity, cost control, efficiency, staff criteria, and project criteria), quantitative output criteria (quantitative indicators, turnover, unit result), qualitative output criteria (individual's satisfaction, individual's complaints), and effect or result criteria (social effects and realization of political goals). Based on the information gathered from respondents' answers about the goals and criteria, the type of PMS use was identified within each of the 5 classifications. The questionnaire also includes questions related to performance measurement indicators in the 5 categories mentioned above (input, process, quantitative output, qualitative output, and result).

4. Result

4.1 Descriptive statistics

The results of the descriptive statistics of the samples, which aim to obtain demographic information for the research, are as Table (1) follows:

Table 1. Demographic information

Description		Number	Percent
Gender	Women	12	91%
	Men	132	9%
Degree	Diploma or less	1	0%
	Bachelor's	41	28%
	Master's	95	66%
	Ph.Ds	7	6%
Year of managerial work experience	<5	45	32%
	5-10	42	29%
	10-20	45	31%
	20>	12	8%
Position	General manager	37	26%
	Deputies	44	31%
	Heads of departments	53	36%
	Experts	10	7%

Out of the 144 questionnaires collected from the statistical population, there were 7 participants (4%) with less than 5 years of work experience (3 of whom were general managers, 3 were heads of departments, and 1 was a deputy), 15 people (10%) with 5 to 10 years of work experience (2 were general managers, 2 were deputy directors, 9 were heads of departments, and 2 were experts), 71 people (49%) with 10 to 20 years of work experience (22 were deputy directors, 15 were general managers, and 34 were heads of departments), and finally, there were 51 participants (35%) with more than 20 years of experience (17 were general managers, 19 were deputy directors, 12 were heads of departments, and 3 were experts).

In order to ensure validity in this research, both content validity (expert opinion) and construct validity have been utilized. The significance criterion for factor loadings is set at 0.4 or higher. For Cronbach's alpha and composite reliability (CR), a value of at least 0.7 is considered acceptable, while for average variance extracted (AVE), values above 0.5 are deemed acceptable. The average variance extracted serves as a test for both convergent and divergent validity (Fornell and Larcker, 1981). Questions 36, 96, 45, 30, 31, and 97, which are related to the variable but do not contribute to its concept, have been removed to increase the average variance of the extracted variable of operational use. The fit of the measurement model after these adjustments is shown in Figure 2.

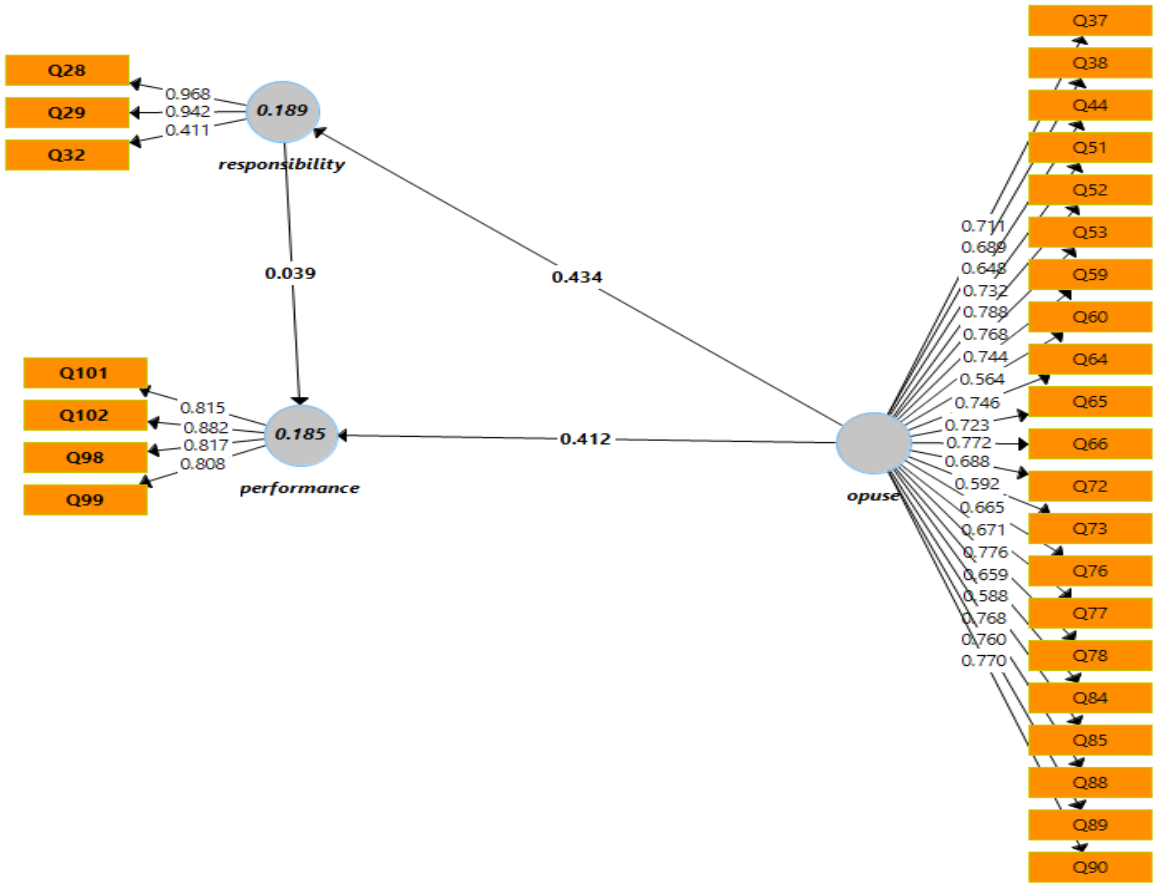

Figure 2. The fit of the measurement model and factor loadings

According to the results summarized in Figure 2, all factor loadings of observable variables are greater than 0.4, which is considered suitable for constructing the model. Additionally, the t-values of the indicators exceed 2.58. Analysis of the explained variance (R2) reveals that the variable of operational use accounts for 0.18 of the variance in the performance variable and 0.18 of the variance in the responsibility variable, serving as an estimate for the internal model. The values of the factor loadings and coefficient of determination can be found in Figure 2, so a separate table is not provided. Table (2) displays the factor loadings of the operational use variable, demonstrating the extent to which each dimension corresponds to our hidden variables.

Table 2. Factor loadings of the operational use variable

Classification	Item number	Dimension	Factor loading
	Q37	Budget allocation	0.710

Input	Q38	Process monitoring	0.680
	Q44	Reporting to senior management	0.640
	Q51	Operational planning (capacity allocation)	0.730
	Q52	Budget allocation	0.780
Process	Q53	Process monitoring	0.760
	Q59	Reporting to senior management	0.740
	Q60	Reporting to stakeholders outside of the organization	0.560
	Q64	Operational planning (capacity allocation)	0.740
Quantitative output	Q65	Budget allocation	0.720
	Q66	Process monitoring	0.770
	Q72	Reporting to senior management	0.680
	Q73	Reporting to stakeholders outside of the organization	0.590
Qualitative output	Q76	Operational planning (capacity allocation)	0.660
	Q77	Budget allocation	0.670
	Q78	Process monitoring	0.770
	Q84	Reporting to senior management	0.650
	Q85	Reporting to stakeholders outside of the organization	0.580
Result/Effect	Q88	Operational planning (capacity allocation)	0.760
	Q89	Budget allocation	0.760
	Q90	Process monitoring	0.770

As shown in Table (2), the variable related to operational use at the input level is best explained by the dimension of budget allocation with the highest operational load, prioritizing it. At the process level, the dimension of budget allocation has the greatest impact in explaining this variable. Additionally, at both the quantitative and qualitative output levels, the dimension of process monitoring takes priority over other dimensions. Lastly, at the result level, the dimension of process monitoring has been given the highest priority.

Table 3. Factor loadings of performance and responsibility variables

Variable	Item number	Dimension	Factor loading
performance	Q98	The number of services provided in the unit	0.810
	Q99	The accuracy of the work provided	0.800
	Q101	Achieving goals in the levels of services provided	0.810
	Q102	Efficiency of operations within the organizational unit	0.880
responsibility	Q28	Unit activities in line with public interests	0.960
	Q29	The performance (efficiency and effectiveness) of the organizational unit in line with the public interest	0.940
	Q32	Existence of activities over the results and performance of the organizational unit	0.410

The statistical output for the performance variable in Table (3) indicates that the dimension "operational efficiency within the organizational unit" with the highest factor loading has the greatest significance in explaining this variable. In regards to the responsibility variable, the dimension "in line with the public interest" of the organizational activities holds greater priority and importance.

Table 4. Convergent reliability and validity of the measurement model

Variable	Cronbach's alpha	Composite reliability (CR)	Average Variance Extracted (AVE)
Operational use	0.950	0.950	0.500
Performance	0.850	0.890	0.690

Responsibility	0.700	0.840	0.660

The observations reported in Table (4) indicate that the measurement model has adequate reliability, with Cronbach's alpha and composite reliability above 0.7. The validity of the model has been measured using two methods: convergent and divergent validity. Values above 0.5 in the average variance extracted, as shown in Table (4) (Chin, 2010), indicate the model's appropriate convergence validity. For proper divergent validity (using the Forner-Larker method), the square root of AVE values on the main diameter in the correlation matrix for each construct should be greater than its correlation values in the lower and left houses of the main diameter. This can also be observed in Table (5). Therefore, it can be concluded that the hidden variables in the model interact more with their indicators than with other structures in the model.

Table 5. Divergent validity of the measurement model

Variable	Operational use	Performance	Responsibility
Operational use	0.700		
Performance	0.420	0.830	
Responsibility	0.430	0.210	0.810

The results of the research hypotheses test based on structural equations using the partial least squares method are shown in Figure 2. When the t-value is greater than 1.96 or less than -1.96, it confirms the research hypotheses. According to Figure 2, the test results confirm the first hypothesis, which states that operational use directly and positively affects performance at a significance level of 0.01 (with a path coefficient of 0.41 and a t-value of 4.36). The second research hypothesis is also confirmed at a significance level of 1% (with a t-value of 6.14 and a path coefficient of 0.43). Therefore, the operational use of PMSs positively and significantly affects organizational responsibility.

The third hypothesis, which examines the mediating role of the responsibility variable in the relationship between operational use and performance, is rejected based on the Sobel test. Contrary to expectations, the responsibility variable does not act as a mediator. The calculated Sobel test value is 0.29, lower than the required value of 1.96. Thus, the third hypothesis is not confirmed.

After examining the measurement fit, the goodness of fit of the structural model is assessed. As shown in Table (6), the model has a strong predictive power based on the optimal Q2 index (0.02 is low, 0.15 and above 0.35 is strong) for endogenous structures. The standardized root mean square residual (SRMR) is also used as an approximate measure for the goodness of fit of the structural model. In this research, the SRMR is 0.08, below the significance level of 0.08.

Table (6) provides information about the quality of the measurement model. The SSO index represents the sum of squared observations for each hidden variable block, while SSE shows the sum of the squared prediction error for each hidden variable block. The Q2 index indicates the validity of the sharing of variables. Based on this index, the measurement model is of suitable quality.

Table 6. Quality of measurement model

Variable	Q^2(=1-SSE/SSO)	SSE	SSO
Operational use	0.450	1658.930	3024.000
Performance	0.460	306.790	576.000
Responsibility	0.420	247.220	432.000

5. Conclusion and implications

As mentioned in the theoretical foundations, Performance measurement is a continuous thing that requires development. Therefore, the research in the field of performance measurement and the expansion of its concepts towards organizational variables such as organizational responsibility gives the designers of PMSs a more comprehensive attitude towards the indicators in the review stage and creates balance in the definition of criteria. In this regard, the current research aims to investigate the relationship between operational use with organizational performance and operational use with responsibility (as mentioned earlier, we have envisioned three uses for PMSs: exploratory, incentive-oriented, and operational use). Also, the mediating role of responsibility has been investigated as part of the complex concepts of organizational structure and PMSs. The results of the first hypothesis based on the effect of operational use on performance at a significance level of 0.01 align with the research of Speklé and Verbeeten (2014) and Verbeeten (2008). Their research named the operational use variable as the most common role of PMSs and confirmed that performance measurement is purposeful and valuable. These are the goals that determine the values. For this reason, the three concepts of operational planning, budget allocation, process monitoring, reporting to senior management and reporting to stakeholders outside the organization as the dimensions of this variable in 5 areas of input, quantitative output, process, qualitative output and result and effect, was considered according to the purpose of using the PMS. The results of confirmatory factor loadings on this variable indicate that the dimension of budget allocation in the process area has the highest factor loading. Therefore, the concept of budget allocation, similar to what is seen in traditional PMSs, holds a high priority in the implementation phase, meaning the process in modern PMSs (Currently, Mashhad Municipality's PMS is based on a balanced scorecard). Vosselman and De Loo (2023) stated that in many PMSs, the motivation to access important resources such as budget or the desire to maintain competition prevents innovation in performance measurement. This is called “reactive conformance”. This means that access to funds is still the most important goal of an organization. Additionally, monitoring the process in the quantitative output stage, the process in the result stage, and the process in the qualitative output stage also have the greatest impact on the operational use variable. The process monitoring aspect of the operational use has the greatest impact in explaining this variable. Thus, it is possible to consider the importance of these dimensions in the policies of determining operational indicators in the design stage of the PMS.

Accurate selection of performance measurement criteria at the process level enhances consistency with the PMS. On the other hand, weaker aspects can also be examined when reviewing the measurement criteria. In clearer terms, the weak dimension of responsibility can be strengthened through a clear description of the duties of the organizational unit and providing a framework for the separation of duties based on the results of the activities of that organizational unit. The most significant concern in performance measurement in the public sector is the division of limited tasks among organizational units, and even a comprehensive PMS can measure limited performance dimensions. Neglecting dimensions of performance that cannot be measured undermines organizational values. Performance should be measured within defined tasks and specific responsibilities (Van der Kolk and Kaufmann, 2018).

Considering the rejection of the third hypothesis regarding the mediating role of responsibility in the relationship between operational use and performance, it is possible to suggest that the definition of organizational activities in the studied society still requires more focus and analysis. This may stem from the lack of coordination between the levels of organizational duties, both individual and organizational. Sometimes, the boundaries between individual and organizational responsibility are

so intertwined that separating them becomes challenging for the responsible person. Additionally, organizations establish performance measurement criteria based on their intrinsic and essential characteristics, and Mashhad Municipality is no exception. In his research, Mousavi (2016) pointed out the diversity and heterogeneity of mission statements in the activities of municipal subordinate organizations and called for a degree of caution in generalizing her results to other parts of the PMS. Suri and Karami (2013) also highlighted in their research that responsibility is one of the indicators of organizational excellence. The existence of a responsible force provides the groundwork for the growth and development of the organization, and this happens alongside performance improvement. However, their findings indicate no significant relationship between responsibility (with the concepts of sufficiency and self-control) and performance. They supported their hypothesis by pointing out that differences in environmental conditions and characteristics affect performance.

On the other hand, the central issue in measuring the performance of public sector organizations is the outcome and consequences. Despite the importance of this issue, the performance management system of Mashhad Municipality does not define the area of result and effect (political and social effects). It lacks result and effect indicators in performance measurement. However, Osborn and Golberg emphasized using indicators based on results and consequences in the PMS (Rostami et al., 2014). In the research of Hermansyah (2023), it is stated that the analysis of performance effects and conversion into real financial value can help organizations understand an activity's social, environmental and economic benefits more comprehensively. Therefore, organizations can make better and more sustainable decisions. In addition to measuring the impact of outcomes, this framework aims to provide assurance. Ensuring that the community can still feel the results and effects of an action. Therefore, considering the political and social effects of Mashhad Municipality's performance in the field of urban management, it is suggested that in addition to determining and identifying performance measurement indicators in the field of input, output, and process, special attention should be given to the field of social and political results and consequences, and political and social criteria should be identified and defined accordingly.

As a research limitation, similar to the opinion of Ittner and Larcker (2001), the indicators may not cover some key concepts in the analysis due to the selection of inappropriate criteria or insufficient interpretation of the indicators. For example, we rely solely on the research's reported performance and do not examine whether the public is satisfied with the organizational unit's results. Additionally, the model used is relatively simple, and other factors that impact PMSs, such as differences in behavioral, cultural, and organizational controls, common trust among stakeholders and managers, etc., have not been investigated. Ultimately, due to the distinct characteristics of public sector organizations and the design of PMSs, it is crucial to exercise caution when generalizing the research results.

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RESEARCH ARTICLE

The Impact of Generational Accounting on Environmental Interactive Strategies of Capital Market Companies

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Abstract

Due to environmental tensions and challenges, environmental functions have evolved from mere social responsibility into strategies for sustainable development. Meanwhile, a conflict exists between the interests of companies, external stakeholders, and the social environment, leading to differences in managers' attitudes toward the use of environmental development strategies. This research aims to investigate the effect of generational accounting on the interactive strategies of capital market companies in terms of environmental interaction. The research sample includes 392 managers at various levels of companies listed on the stock exchange during 2021-2022. Additionally, partial least squares (PLS) analysis was employed to fit the model. The research indicates that generational accounting positively and significantly affects environmental interactive strategies in capital market companies. The findings suggest that the integration resulting from the implementation of institutional and governance guidelines at the capital market level fosters interactive values and norms between companies and the environment. This approach not only protects the interests of the current generation but also, based on long-term foresight, mitigates the burden and pressure of environmental costs from the current generation to future generations. This is the first research to investigate the effect of generational accounting on interactive environmental strategies. Although this area is significant for developing theoretical literature and providing a practical foundation for reducing information asymmetry in environmental accounting, there has been limited research.

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1. Introduction

The spread of environmental pollution has caused some measures to be taken to prevent environmental pollution, the destruction of resources, and sustainable use in some developed countries and the world. For this reason, the 1960s and 1970s are periods of awakening and awareness of the environment. In this era, humanity realized the signs of threatening the environment. It was necessary to hold a conference and approve several laws for protection and alignment with sustainable development (Brulle et al., 1996). Interactionist strategies in the environment will help to create qualitative perceptions of decision-makers and managers of economic enterprises to reduce environmental pollution. These strategies are considered a philosophy based on coherent and integrated approaches of mutual action and symbolic interactionism in a social environment based on a prism. A specific norm or procedure will create a unified image of collectivist social behaviors regardless of institutional and legal requirements. In other words, these symmetries can also lead to the expression of meanings and concepts of environmental values in a society, such as the capital market, based on a set of systematic and homogeneous comments. The transparent representation of green accounting practices creates a context for greater integration between companies with environmental protection activities (Pickering and Norman, 2020). On the other hand, the wide range of environmental discourses can help advance the goals of social groups such as NGOs in the cultural formation and development of adherence to environmental norms and thus strengthen the inclusion and generality of environmental perceptions. The noteworthy point is, nowadays, environmental theories with emphasis on creating constructive interactions (harmonies) are trying to show that both macro decisions and policies (supply management) and the type of environmental values and behaviors and actions (demand management) can create help the integration of green behaviors.

Today, accounting, as a comprehensive function, has tried to guide environmental functions by linking financial strategic issues with environmental behaviors more coherently to achieve a sustainable development level (Cho et al., 2022). However, the concept of sustainable development has given a greater role to accounting due to climate change because it considers the accounting profession necessary to maintain a constant existence of natural assets and has created an exchange relationship between intergenerational capital and French capital (Gunarathne et al., 2023). In fact, with the increasing pressure on natural resources and limitations in this area, achieving intergenerational accounting has become a challenge. For the development of future environmental strategies, a concept beyond Generational Accounting is needed (Cho et al., 2022). A concept in line with sustainable development and the fair allocation of resources to reduce environmental pollution requires long-term perspectives in accounting to achieve sustainability.

The phenomenon of generational accounting, as a change in nature from classical accounting, a range of functions from planning to budgeting to allocate resources, includes reporting and performance feedback for the benefit of future generations. In this way, sustainable development can be achieved by using financial resources against the environment (Heerden and Schoeman, 2000). In other words, generational accounting is a perspective of financial functions and decisions, the results of which can lead to the creation of a set of interactive processes in the environment (Klumpes, 2001).

Given that, as Kotlikoff and Raffelhusechen (1999) in criticizing classical accounting, relying on the development of environmental perspectives introduces generational accounting as the result of cost and utility, it can be stated that focusing on this concept goes beyond the cost-oriented approach of classical accounting. It tries to help create more integration in environmental interactive strategies by using forward-looking methods in green accounting (Pinheiro, 2021). Reviewing the requirements of Article 190 of the Fifth Development Program Law in Iran also shows that due to

the existence of financial resource limitations, Changing policies for the optimal consumption of resources and reducing government spending credits through the implementation of the green accounting program, including energy consumption management; Water; raw materials and equipment (such as paper); Reduction of solid waste materials and their recycling (in buildings and vehicles). Achieving an integrated level of transgenerational accounting approaches can help to increase environmental interaction strategies. In line with the notification of the regulations of the Environmental Protection Organization and its deputy regarding the development of interactive sustainability functions between the industry and the environment, conducting this research can be fruitful in creating greater integration of the financial functions of companies with the environment. Therefore, relying on the above explanations, the importance of conducting this research can be examined from the following two perspectives.

First, this paper is the first research that examines the effect of generational accounting on interactive environmental strategies. Although past research such as Petera et al. (2021), Singh (2019), and Tu and Huang (2015) respectively review "environmental strategies and green financial reporting, "Commercial sustainability and green management with a focus on financial dimensions" were discussed, but no research has investigated the current issue. Conducting this research can help develop theoretical literature to fill the gap of agency costs in the dimension of environmental functions of the company and expand the theoretical knowledge about the research subject based on the structural characteristics of companies in different societies and capital markets.

Secondly, the results of this research can help regulatory institutions such as policymakers and compilers of financial reporting standards to improve the level of knowledge of information requirements in the field of green performance disclosure, more consistent requirements regarding the development of environmental accounting information disclosure on the one hand, and more culture building to promote an optional level of disclosure of the functions of this field by companies. There is always this concern from theorists in this field that the content contradiction between the values of social behavior and accounting standards due to the lack of an inclusive culture regarding the disclosure of green practices has caused the level of environmental protection in industries to be of little interest and this will cause an increase in environmental pollution and its destruction. Therefore, relying on this level of social and institutional sensitivities towards the environment, this research aims to investigate the effect of generational accounting on the interactive strategies of the environment in capital market companies.

2. Theoretical principles

2.1 Environmental interactionist strategies

In general, the behavior of competing local governments in terms of environmental regulation has been studied in depth. Still, the research perspective is limited to the dynamics of the local governments' behavior and treats each local government as an independent individual, thus ignoring the influence and constraints of local governments' behavior as competitors who cannot satisfactorily explain the universality of the non-complete enforcement of environmental regulations (Gao et al., 2023). More recently, the center of the struggle over economic metaphors has been reshaped around whether nature should be explicitly incorporated into the globally dominant neoliberal and capitalist market economy. Certain economic metaphors – such as ecosystem services – were created to argue for environmental protection (see Bekessy et al., 2018). However, these metaphors' underlying assumptions about human relationships with nature have subsequently informed the bounds of science and policy (Norgaard, 2010). This struggle over economics-focused environmental discourse and its practical implications can be seen in recent debates over the use of

economic metaphors and frameworks for conservation policy (i.e. Wilson and Law, 2016). Pennnycook (1999) believes that interactions are sets of systematic and organized comments that explain the meanings and values of institutions. Environmental interactionist strategies "is an approach that systematically investigates the often ambiguous relationships of causality and determinism between a) interactionist actions, events, and texts; b) It deals with wider social and cultural structures, relationships, and processes. Environmental interactionist strategies are the basis for building identities; social relations and systems of knowledge and meaning help to ground the creation of acceptance and strategic arrangement of texts, and environmental images and ideas have been proposed. Interaction in environmental studies has been proposed in different ways. Many books and works have discussed environmental interactions, but most do not provide phylogenetics. In the following, three typologies of environmental interactions are introduced, which are placed in the form of the interactionist concept of bio-ecology because their view on the environment is global, and ultimately, they support the environment present in Figure 1.

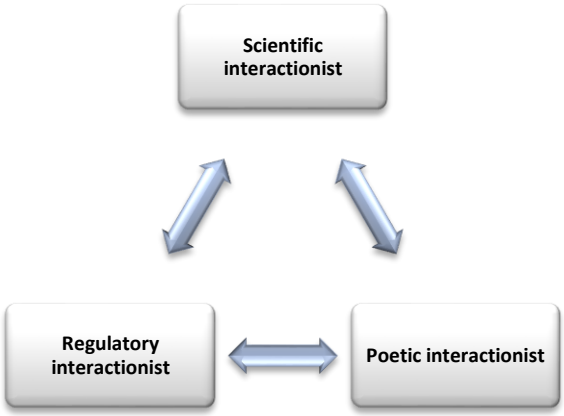

Figure 1. Environmental discourse strategies (Herndl and Brown, 1996)

A) One of the basic efforts to organize the analysis of environmental interaction has been made by Herndl and Brown (1996). "Environmental interactionist model" is in the form of three circles, each placed in a triangle circle. In the left square is "regulatory interactionist", which refers to powerful institutions that make environmental decisions and policies. Here, nature is treated as a resource. In the upper square is "scientific interactionist", in which nature is considered the subject of knowledge created through scientific methods. Policymakers always base their decisions on technical information and expert evidence. Finally, at the exact opposite pole in the right square is "poetic interactionist, " which is based on corporate normative and cultural narratives about nature that emphasize the beauty of spirituality and emotional power. Herndl and Brown (1996) emphasize that these three powerful environmental interactions are often combined and not independent. In such cases, it is better to look for dominant orientations (Rozema et al., 2012). De Tommaso and Rodrigues (2023) acknowledged that a shared value creation system is composed of nine elements, which are business results, social-environmental results, ecosystem, impact, materiality matrix, profitability, purpose-driven leadership, social-environmental welfare and sustainable economic development, can be considered as a basis for strengthening social trust.

B) Another action taken in classifying environmental interactions is Bruhl's (2000) genealogy of argumentative frameworks accepted by the US environmental movement. Based on the literature of environmental philosophy and a detailed study of the history of environmentalism in America, Brule reached nine distinct interactions:

- Manifest Destiny (the extraction and development of natural resources give the environment a

value it would otherwise lack).

- Wildlife Management (scientific management of ecosystems can ensure the survival of sustainable wildlife populations for recreational purposes such as hunting).
- Conservation (natural resources should be managed technically using a utilitarian approach).
- Preservation (the range of wildlife must be protected from human invasion because it has spiritual and aesthetic value).
- Reform Environmentalism (ecosystems must be protected for human health).
- Deep Ecology (diversity of life on earth must be preserved because it has intrinsic value).
- Environmental Justice (environmental problems are the reflection and result of fundamental social inequalities).
- Ecofeminism (abuse of the ecosystem shows men's dominance and lack of attention to the order and cycle of nature).
- Ecotheology (humans must protect nature because they are God's creation).

Existing studies have noted the explanations of local governments' behavior on the incomplete implementation of environmental regulations and described some conceptual terms, such as selective implementation, symbolic implementation, negative implementation and policy implementation bias (Cao et al., 2023). Herndl and Brown (1996) believe this multiplicity of interactions has fragmented the American environmental movement and prevented it from speaking with a unified voice to a nationally informed audience. Proponents of these reasoning frameworks talk to each other in the process of doubt and lack of mutual understanding. Like Schneiberg and his followers, Brulle (1996) concludes that no meaningful environmental action can exist without real structural change. As long as the discourses related to the environment cover the social origins of indigenous life and claim a coherent view of the general good of the environment, this is unlikely to happen.

C) John Hannigan also identifies three environmental interactions in Table (1): Arcadian interaction, ecological interaction, and environmental justice interaction.

Table 1. Characteristics of homophones of environmental interactions of Brulle (1996)

Consonant type of environmental interaction	Description
Arcadian interactionism	Van Koppen (2000) states three characteristics of Arcadia's interactionism: externality, Illustration, and completion. Externality means that Arcadian nature is constructed as external to human society or removed from everyday urban life. Imagery shows that the image of nature in the Arcadian tradition is placed in the cultural memory through visual images and stereotypes. Finally, the Arcadian tradition can best be understood through the complementarity framework. In other words, the Arcadian tradition is at the opposite point of the urban industrial society and all the related social and environmental problems.
Ecosystem Interactionist	The second major interaction that has shaped how we deal with nature and the environment is based on the concept of ecology. Referring to the terminology of Herndl and Brown (1996), it can be said that the scientific discourse is the dominant tendency in this interaction.
Environmental justice Interactionist	In the 1980s, a new set of forms of interactionism emerged in the United States, which were very different from mainstream interactions in interpreting environmental problems and priorities. Environmental justice raises a series of lawsuits related to toxic pollution, according to the civil rights of those who were harmed, and not in relation to the rights of nature.

2.2 Generational accounting

This approach of accounting to develop environmental sustainability was proposed for the first time by Kotlikoff (1984). This approach initially tried to analyze the burden of the government's expenses and payments by separating the current and future generations in terms of obtaining resources and future limitations. Taylor (2013) outlined a generational accounting approach based on two main goals that are presented in Figure 2:

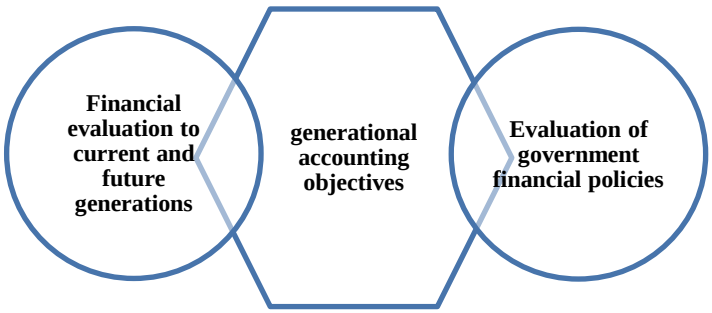

Figure 2. Goals of the generational accounting approach

Therefore, generational accounting evaluates the ability to bear the government's financial policies in different age groups. On the other hand, it examines whether the ability to bear such a financial burden is possible for the current and future generations. In describing this approach, Kotlikoff (1984) stated that the total current debt of the government, because it remains for future generations, is likely to increase the pressures on the future generation due to the achievement of resource scarcity. Based on the cost-oriented nature of generational accounts, the net present value of taxes paid by the current generation is probably compared with the net present value of government accounts. The difference between the two represents the financial burden imposed by the present generation on the shoulders of the future generation; it is a function based on creating the pressure of providing resources in the future. Suppose the environment is considered a resource based on sustainability. In that case, implementing generational accounting by creating incentives such as discounts and green tax exemptions improves utility by reducing environmental pollution for future generations (Arévalo et al., 2019). Leibfritz (1996) considered generational accounting as a factor in achieving the following consequences from an environmental perspective presented in Figure 3:

All four of the above consequences seek to balance cost and utility in generational accounting to preserve the environment as a natural resource for future generations. Also, Rounaghi (2019) uses green accounting to study the basics of the generation field in accounting to develop green tax policies. Environmental education and preventing the reduction of natural resources were divided into the following three sections, presented in Figure 4.

In the field of social welfare, generational accounting, with the assumption of creating tax justice, tries to meet the needs and demands of the future generation by preventing costs imposed on natural resources while creating the welfare of the current generation to avoid erosion and destruction of natural resources. On the other hand, in the field of population, generational accounting based on transfer payments from the current population to the future population tries to prevent the imposition of current costs on the future. The generation of generations in societies is a

condition for the stability of governments to preserve and protect natural resources, and education to the first generations can guarantee the population's stability in future generations. Finally, it should be stated that generational accounting is not developed only to explain generational balance. Still, it also tells how to change policies to distribute green justice to the current generation. Therefore, politicians trying to achieve their goals may base their activities on current expenses and neglect long-term investment and investors, so they will not have the ability to support the next generation and will have to increase tax rates, which can be an effective factor in generational accounting and intergenerational balance (Ablett, 1996).

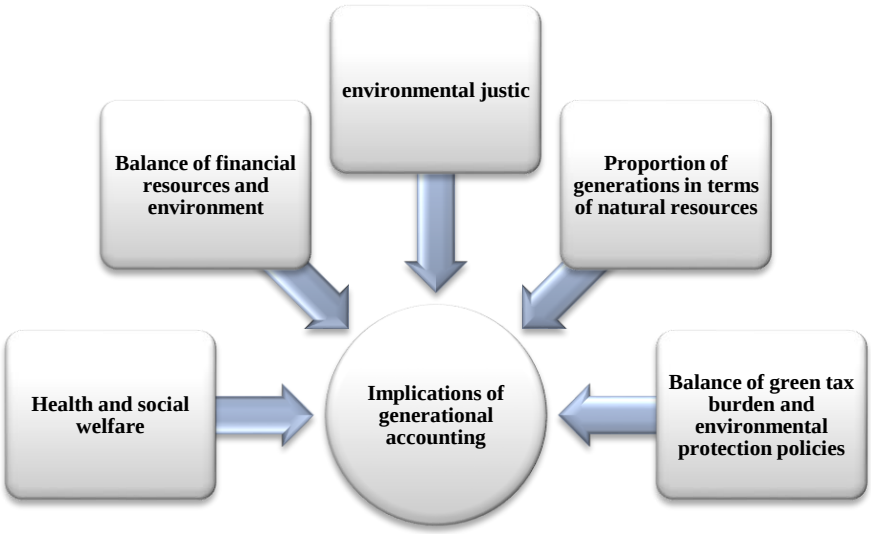

Figure 3. Generational accounting consequences

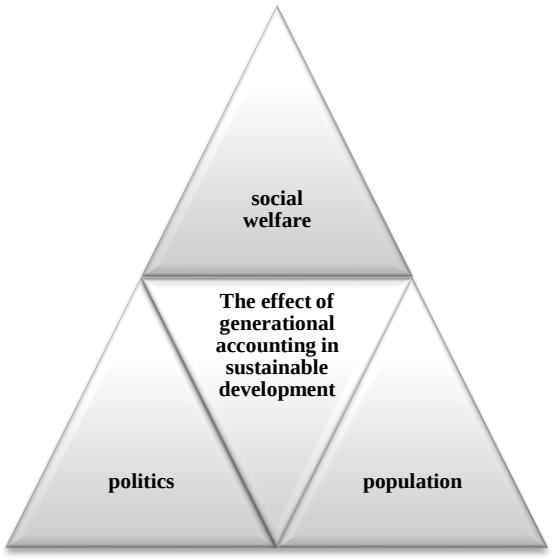

Figure 4. The role of generational accounting in the development of green sustainability

2.3 Generational accounting and interactive environmental strategies

An important part of every country's economic system is dependent on the environment, and government policies and programs can be effective to some extent in creating integration in the functional field of companies against social expectations. The issue of generational accounting is an important part of institutional supervision through which governments try to use the role of accounting in various tax, political, and economic fields to prevent the imposition of environmental costs (Stranieri et al., 2021). Undoubtedly, the result of such continuous monitoring of the financial functions of companies can create more balanced values and norms of interaction between the social environment and the response functions of companies because the created values and norms define a more stable path of social expectations in environmental protection for companies. With the market environment becoming more competitive in protecting the environment, companies in this field will be more successful if they have higher voluntary disclosure capacities regarding environmental costs (Chan et al., 2022). In fact, as Kotlikoff (1984) stated in explaining the concept of generational accounting, a balanced level of cost and benefit for companies will be created through this approach in green accounting, which can strengthen the interactivity of environmental strategies (Draper et al., 2014).

Although theories such as political economy theory, legitimacy theory, stakeholder theory, and information symmetry theory based on accounting and financial reporting purposes require that information related to the environmental behavior of companies should be disclosed favourably and make access to this information possible for everyone to improve the level of interactive values between the company, analysts, and investors, the facts are that due to the existence of conflicts between the stakeholders and the companies, there is a lack of incentives to disclose environmental information. Therefore, by understanding these conflicts, generational accounting is trying to strengthen environmental interactive strategies more dynamically by creating a balance in cost and benefit based on integrated values and norms through learning the macro and micro approaches of environmental performance (Decoster et al., 2014). Concern about the power-seeking attitude of companies towards the disclosure of environmental and functional information of companies has always been considered a dominant reason among capital market observers and researchers in this field because management plays the main role in the main direction of company activities (Choi and Szewczyk, 2018). By accepting this limiting factor in the formation of green accounting values, environmentalists of the behavioral school believe that to solve the environmental problems of companies and disclose optional information, it is necessary to change the direction from physical and ecological sciences to behavioral and moral sciences by creating environmental discourse strategies. Because these sciences seem to have a good potential for developing ways to improve the environment due to managers' understanding of the conflicts between the company and the social environment (Brauch, 2011), the goal of dynamism and strengthening the consonance of environmental discourses is to develop the qualitative perceptions of decision-makers and managers of economic enterprises to reduce environmental pollution. This approach, aligned with green accounting dimensions, can also help increase information transparency. Therefore, relying on the theoretical issues raised, the hypothesis of the research is presented as follows:

Research hypothesis: Generational accounting significantly affects interactive environmental strategies at the level of capital market companies.

3. Research methodology

This study is considered practical in terms of the type and nature of the investigated issue and its purpose. In this study, in terms of the data collection process, the research is included in the quantitative/descriptive survey-correlation category since the required data were collected based on a survey. Therefore, the questionnaire was used to collect research data because, following previous

studies, it is an effective method of collecting data from a large sample in the applied research category. Also, the library method and the theoretical bases of similar studies were used to collect the required principles. The period of questioning the subjects is six months, which includes the last three months of 2021 and the first three months of 2022.

3.1 The statistical population of the research

The statistical population in this research is the managers of different levels of companies admitted to the stock exchange during the research period, which is assumed to be unlimited due to the lack of official statistics. Therefore, to determine the sample size, Cochran's formula is used with the assumption of an unknown statistical population as follows:

$$n = \frac{Z_{\frac{\alpha^2}{2}} pq}{d^2}$$

In this equation: n = number of samples; $Z_{\frac{\alpha^2}{2}}$= the standard normal value, that is, the number 1.96; pq = ratio of the variable attribute, i.e. 0.5; d^2= the probability of measurement error is equal to 0.05. Now, according to the following calculation:

$$\frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} \cong 384$$

According to the above relationship, a sample size of 384 people was obtained. To increase the validity of the research, 430 questionnaires were randomly distributed among the participants; finally, 392 questionnaires were received and became the basis of statistical analysis.

3.2 Research tools

The research data collection tool was a questionnaire. The questionnaires used in this research were standard. The questions of all the questionnaires were arranged using a 5-point Likert scale from completely agree to completely disagree. Below is the operational measurement method for research variables.

3.2.1 Independent variable

The format of past research on generational accounting has been evaluated in the form of the following proposed equation.

Current Generation Net Current Tax Payments + Future Generation Net Current Tax Payments Value = Future Government Net Current Expenditures Value (Wealth) Governments Net Assets

Considering that the data resulting from the above equation is usually not fully disclosed due to the difference in government policies in disclosing environmental performance information, a questionnaire adapted from Gokhale et al. (1995) has been used in this research. This questionnaire, which includes eight questions and two subscales, is assessed through a 5-point Likert scale. The two criteria of this questionnaire include sustainability macro-functions and operational micro-functions. In macro sustainability functions, generational accounting performance is based on measuring companies' environmental tax characteristics to the government's political expenses. It includes the dynamics of market competition and economic growth. In contrast, in small functions, the performance of generational accounting includes establishing a green internal control system, green reward incentives for managers, Green education and green production infrastructure. For example, at the level of macro-sustainability functions, it has been suggested whether companies' voluntary disclosure of green operating costs can help environmental sustainability. Can the government help to reduce environmental and political costs by creating financial incentives? Can

the creation of competition in the market of green products lead to an increase in investment returns in the capital market? Can the integration of green functions of companies in the disclosure of environmental functions help economic growth? The reliability of this questionnaire was estimated based on Cronbach's alpha coefficient, which was equal to 0.79, which was more than 0.7, so this questionnaire was approved.

3.2.2 The dependent variable

The dependent variable of this research is environmental interactionist strategies. Herndl and Brown's (1996) questionnaire was used to measure this variable, and it included 12 moderated questions regarding the three dimensions of this strategy (policy, scientific, and narrative strategies). This questionnaire is based on a Likert scale that includes the range of completely agree (5 points), I agree (4 points), I have no opinion (3 points), I disagree (2 points); and I completely disagree (1 point). It examines the level of functions of environmental interactions in the capital market, which examines the role of the institutional power of companies in developing environmental policies. On the one hand, in the form of regulatory interaction and the framework approach of information feedback among companies to formulate procedures for sustainable environmental development, in the form of knowledge-building interaction. On the other hand, it finally discusses and examines narrative interaction to align the expression of environmental interactions of companies based on moralism and spirituality. Due to its standardization, the validity of the questionnaire was confirmed, and its reliability was confirmed as 0.87 in Murphy's research (2018).

Therefore, relying on the definition of research variables and according to the nature of formulated hypotheses, the theoretical framework of the research is presented in Figure 5:

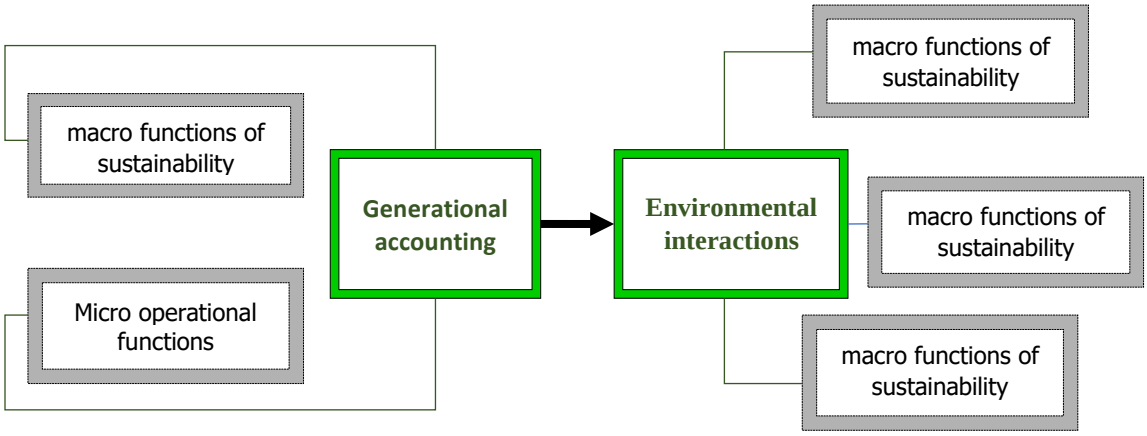

Figure 5. Theoretical framework of research hypothesis testing

4. Research findings

4.1 Descriptive Statistics

According to Table (2), the highest average is related to the narrative interaction strategy subscale (4.282), which indicates that a kind of collective effort to describe environmental functions in the form of social norms is being formed by companies. It can determine the future perspective of the interaction of industries with the environment in a more dynamic way. On the other hand, it was found that the highest standard deviation is related to the law enforcement interaction variable with a standard deviation value of 0.99, which means that companies and participants believe that

coherent and integrated approaches regarding the effective monitoring of the protection of related institutions on the environment do not accept and this issue has caused a kind of confusion and non-formation of a coherent regulatory requirement.

Table 2. Descriptive statistics related to research variables

Variable	Subscales	Sign	Mean	Median	Minimum	Maximum	Standard deviation
Environmental Interactionist Strategies	Regulatory interactionist	Regulatory Interactionist	3.841	4.210	1.000	5.000	0.960
	Scientific interactionist	Scientific Interactionist	4.169	4.232	1.000	5.000	0.720
	Poetic interactionist	Poetic Interactionist	4.291	4.521	1.000	5.000	0.650
Generational Accounting	macro functions of a sustainability	Sustainability Macro Functions	3.117	3.268	1.000	5.000	0.490
	Operational micro-functions	Operational Micro Functions	3.036	3.505	1.000	5.000	0.810

4.2 Inferential statistics

Three reliability criteria, convergent validity, and divergent validity are used in fitting measurement models. In order to check the reliability of the research measurement model, factor loading coefficients, Cronbach's alpha coefficients and composite reliability are used.

Table 3. Coefficients of factor loads

Variable	Factor	Index	Factor load
Environmental Interactionist Strategies	Regulatory Interactionist	Regulatory Interactionist	0.510
	Scientific Interactionist	Scientific Interactionist	0.760
	Poetic Interactionist	Poetic Interactionist	0.830
Generational Accounting	Sustainability Macro Functions	Sustainability Macro Functions	0.450
	Operational Micro Functions	Operational Micro Functions	0.770

The criterion value for the appropriateness of factor loading coefficients is 0.4. According to Table (3), all the coefficients of factor loadings of the questions are greater than 0.4, which shows the appropriateness of this criterion. According to the data analysis algorithm in PLS, after measuring the factor loadings of the questions, it is time to calculate and report Cronbach's alpha and composite reliability coefficients, which are shown in Table (4).

Table 4. Results of Cronbach's alpha criterion and composite reliability of hidden research variables

Hidden Variables	Signs	Cronbach's Alpha coefficient (Alpha> 0.7)	Composite reliability coefficient
Environmental Interactionist Strategies	Regulatory Interactionist	0.830	0.880
	Scientific Interactionist	0.870	0.910
	Poetic Interactionist	0.760	0.850
Generational Accounting	Sustainability Macro Functions	0.840	0.880
	Operational Micro Functions	0.880	0.910

Considering that the appropriate value for Cronbach's alpha and composite reliability is 0.7, and according to the above table's findings, these criteria have adopted a suitable value for the variables, so it is possible to confirm the appropriateness of the reliability of the research measurement models. The second criterion for examining the fit of measurement models is convergent validity,

which examines the degree of correlation of each construct with its questions (indices).

Table 5. Convergent validity results of hidden research variables

Hidden Variables	Signs	Extracted average variance
Environmental Interactionist Strategies	Regulatory Interactionist	0.660
	Scientific Interactionist	0.710
	Poetic Interactionist	0.590
Generational Accounting	Sustainability Macro Functions	0.610
	Operational Micro Functions	0.730
	Regulatory Interactionist	0.680

According to the findings of Table (5), the AVE criterion for the underlying variables has adopted an appropriate value of more than 0.5; as a result, the appropriateness of the convergent validity of the research is confirmed.

According to Table (6), the root mean value of the shared values of the hidden variables in the present study, which are located in the houses in the main diagonal of the matrix, is greater than the correlation value between them, which are located in the lower and right houses of the primary diameter. Each construct in the research model interacts more with its indicators than others. This shows the appropriate divergent validity and appropriate fit of research measurement models.

Table 6. Fornell and Larcker matrix to check divergent validity

Factor	Sign	RI	SI	PI	SMF	OMF
Regulatory Interactionist	Regulatory Interactionist	0.810				
Scientific Interactionist	Scientific Interactionist	0.090	0.840			
Poetic Interactionist	Poetic Interactionist	0.230	0.460	0.770		
Sustainability Macro Functions	Sustainability Macro Functions	0.570	0.240	0.330	0.830	
Operational Micro Functions	Operational Micro Functions	0.570	0.240	0.330	0.160	0.830

In the current research, two criteria, coefficient of determination (R2) and coefficient of predictive power (Q2), have been used. According to the Table below, the value of R2 has been calculated for the endogenous structures of the research, which can confirm the appropriateness of the fit of the structural model. In addition, to check the predictive power of the model, a criterion called Q2 was used. According to the results of this criterion in Table (7), it can be concluded that the model has strong predictive power.

Table 7. Values of determination coefficient (R2) and prediction power coefficient (Q2)

Factor	Sign	R2	Q2
Regulatory Interactionist	Regulatory Discourse	0.270	0.170
Scientific Interactionist	Scientific Discourse	0.600	0.120
Poetic Interactionist	Poetic Discourse	0.690	0.360
Generational Accounting	Generational Accounting	0.400	0.440

After examining the fit of the measurement and structural models, the general model of the structural equations of the research should be checked using the Goodness of Fit (GOF) criterion, with three values of 0.01, 0.25 and 0.36 as follows: weak, medium and strong values for GOF. This criterion is calculated through the following formula:

$$GOF = \sqrt{\overline{Communalities} \times \overline{R^2}}$$

Where

Communalities = Average common values of hidden variables and $\overline{R^2}$: the average values of the coefficient of determination of endogenous variables of the model.

Table 8. Communality and R^2 of research variables

Hidden Variables	Sign	Communality	R^2
Regulatory Interactionist	Regulatory Discourse	0.660	0.270
Scientific Interactionist	Scientific Discourse	0.710	0.600
Poetic Interactionist	Poetic Discourse	0.590	0.690
Generational Accounting	Generational Accounting	0.440	0.400
Environmental Interactionist Strategic	Environmental Interactionist Strategic	0.510	

Table 9. The fitting results of the general model

Communality	R2	GOF
2.630	0.480	0.0540

According to the value obtained for GOF of 0.54, the overall model is confirmed to be a very good fit. After examining the fit of the measurement models and the structural model and having a proper fit of the overall model and according to figures 6 and 7, the results of the research hypothesis test are discussed, presented in Tables (8) and (9).

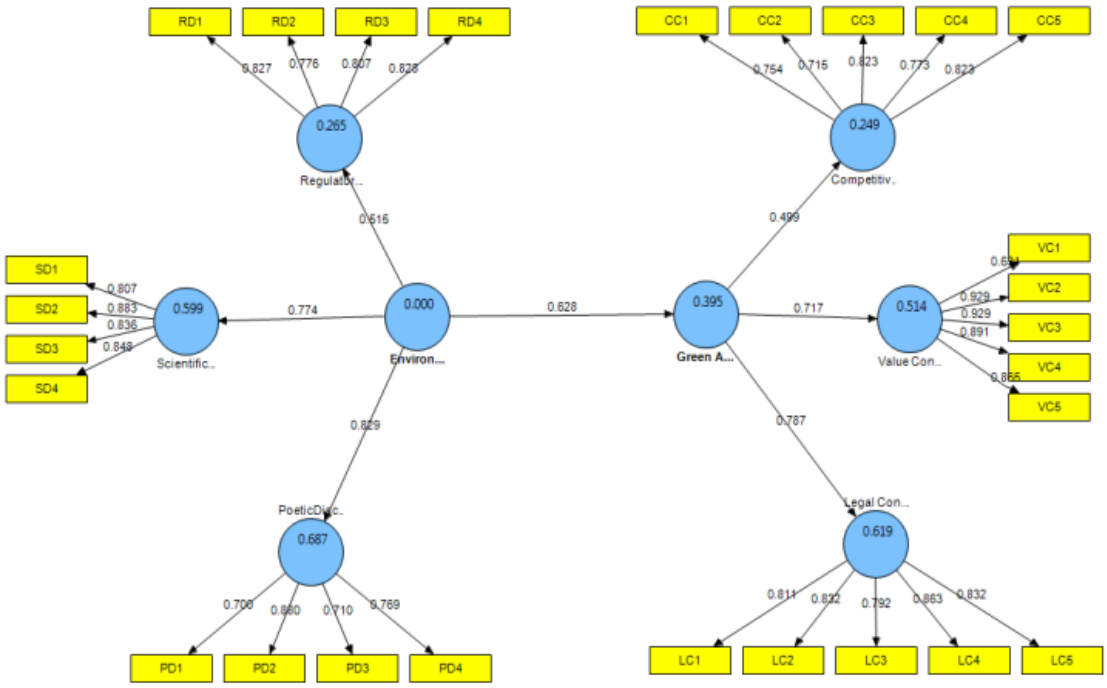

Figure 6. Structural model of the research hypothesis with factor loading coefficients

Table 10. The results of the research hypothesis test

Hypothesis	Causal relationships between research variables	Path coefficient (β)	Significance (T-value)	Test result
H1	Generational accounting significantly impacts environmental interactive strategies at the level of capital market companies.	0.620	6.120	Confirmed

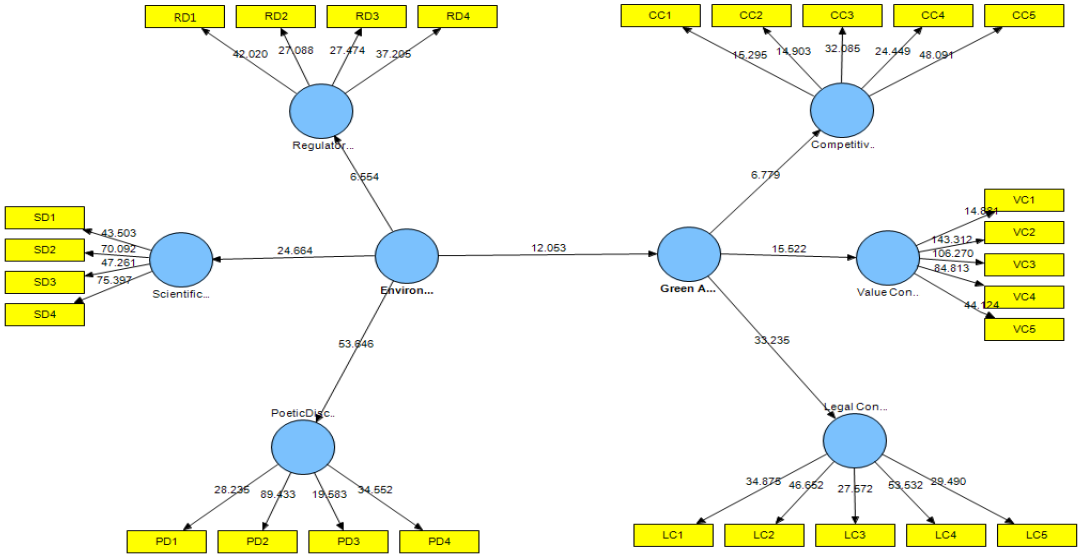

Figure 7. Structural model of research hypothesis with significant coefficients

According to Figures 6 and 7, the standardized coefficient (path coefficient) between research variables was determined based on the fit of the model in the research hypothesis test, generational accounting on the interactive environmental strategies of capital market companies with a positive path coefficient (β) 0.62) and the t statistic between two variables is equal to (12.06), which confirms the research hypothesis present in Table 10.

5. Discussion and conclusion

This research aims to investigate the effect of generational accounting on environmental interactionist strategies. The results showed that generational accounting positively and significantly affects environmental interactive strategies. Since generational accounting has two macro and operational mechanisms and seeks to develop environmental perspectives in accounting, it can be concluded that focusing on financial and institutional functions in green accounting will lead to the creation of strategic environmental interactions because the integration resulting from the implementation of institutional and governance guidelines at the level of the capital market creates a level of interactive values and norms between companies and the environment. Protecting the interests of the current generation, based on a long-term perspective, prevents the burden and pressure of environmental costs from the current generation to the future generation. Environmental interactionist strategies are considered to be a kind of development of inclusive perceptions in social contexts with the decisions of company managers that, based on the effectiveness of generational accounting, will lead to an increase in information transparency from the perspective of macro-sustainability activities and operational functions, such as environmental costs. These strategies are a philosophy based on coherent and integrated approaches of mutual action and symbolic interactivity between the company and social expectations. Based on a charter, a specific norm or procedure is carried out regardless of institutional and legal requirements and displays a unified image of social collectivist behaviors. The issue of generational accounting is considered an essential part of institutional supervision, based on which governments try to use the role of accounting in various tax, political, and economic fields to prevent the imposition of environmental costs to create more balanced values and norms of interaction between the social environment and the response functions of companies. That occurs because the created values and norms define a

more stable path of social expectations in environmental protection for companies. As stated by Kotlikoff (1984), in explaining the concept of generational accounting, a balanced level of cost and benefit for companies will be created through this approach in environmental values, which can strengthen the interactivity of environmental strategies. The result obtained is in line with that of Cho et al.'s research (2022), Pickering and Norman (2020), and Klumpes (2001).

Implications

The results of this study can help the development of generational accounting to incorporate long-term implications of fiscal policy on intragenerational (within generations) and intergenerational (across generations) distribution and fiscal sustainability while including future changes in the demographic structure of the population. Moreover, the result of this study suggested to the legislators and policymakers of this field that through holding environmental accounting workshops and training courses, they should be given the necessary training to understand better the factors affecting reduced environmental pollution and maintaining its sustainability in the long term. In addition, it is suggested to the editors of university course topics and those in charge of accounting education to consider the environmental accounting lesson and its topics when compiling the accounting education topics so that in this way, the accounting students have the necessary knowledge and skills to protect from natural sources. On the other hand, it is suggested that the elements of corporate governance, according to the nature of the industry and their strategic activities, by using the knowledge of experts and in cooperation with consulting institutions to improve the effectiveness of generational accounting, to direct the financial systems towards a more realistic and transparent disclosure of environmental performance and creating an atmosphere of cooperation with thinkers in this field helps to improve the level of competitive functions and interactive value of the environment. Finally, it is suggested that the research and development teams and units, by analyzing the level of interests and the existence of conflict between the interests of companies and the social environment while promoting the knowledge of managers in formulating environmental-centred interaction strategies, try to make the pillars of financial reporting more balanced in interest between the company and the environment towards dynamics.

Limitations

Many of the empirical objections are related to the assumptions regarding the projections of the variables, not only for the population but mainly for our economic variables. One of this study's limitations is the collection of qualitative data on generational accounting. This variable has been small due to the economic and environmental parameters in most of the prior research. In this study, we faced limitations such as the participants' mutual understanding regarding this issue. On the other hand, another limitation of this study is related to the selection of participants, which seems to be that if specialized people had participated in this study using more specialized analysis, more reliable results would have been presented.

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RESEARCH ARTICLE

The Relationship between Monetary Policy and Financial Condition Index (MSIHA Approach)

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Abstract

Monetary policy is one of the critical economic policies that affect the macro variables of every country. The Financial Condition Index (FCI) is one of the composite variables affected by monetary policy. This study aimed to measure the effect of monetary policy through different channels on Iran's FCI. The FCI was first calculated using time series data from 1991-2023 and the Principal Component Approach econometric method. The effect of monetary policy on the country's FCI using the Markov-switching (MSIHA (2) AR (2)) model was calculated and estimated. The results of the estimation of the Markov-switching model indicate that the studied period can be divided into two regimes of zero and one. These results are consistent with research hypotheses and theoretical foundations, which is not far from expected considering the economic conditions.

Keywords:
Condition Index, Financial Markov-Switching, Monetary Policy, Principal Component Approach

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1. Introduction

Monetary policies affect the macro variables of each country. One composite variable affected by monetary policy is the Financial Condition Index (FCI). It is worth mentioning that the FCI is the weighted mean of the variables of the exchange rate, interest rate, stock price, housing price, bank facilities, and net foreign assets, in which the effect and weight of each of these variables on the FCI are different. Monetary policy affects the FCI through various channels, such as interest rate and currency, stock price index, housing price index, and the volume of money.

The implementation of monetary policy through interest rate changes does not have a significant effect on investment. In addition, the credit channel is more important than the interest rate when the contractionary monetary policy is applied. After implementing the contractionary monetary policy, the number of bank deposits and, accordingly, the number of bank credits will decrease.

Researchers in financial markets are looking for a suitable index to measure the pressures of monetary policy on economic variables. This index includes the main price of the economy: bank interest rate, stock price, exchange rate, and housing price. Usually, they are called FCI. One of the advantages of these indices is that they show the effects of monetary policy on financial assets and, in turn, can predict production and inflation through the central bank's monetary policy mechanism. The International Monetary Fund and the economic conditions assessment index present price changes and production fluctuations. Although monetary policy aims to stabilize prices, maintaining economic prosperity is one of its other duties. Therefore, policymakers should not limit themselves to monetary variables but consider mechanisms such as exchange rates, asset prices, and credit volume through which monetary policy affects production and economic activity. Due to the bank-oriented economy, many economic studies have confirmed the importance of monetary policy tools in Iran.

FCI can be defined as the current state of variables that affect economic behavior and the future state of the economy. In other words, the FCI indicates the state of the economy in the future, which is reflected in these current financial variables.

The FCI is a summarized index of current financial variables capable of predicting a country's future state of economic activities.

Viren (2013), various economists, such as Goodhart and Hofmann, designed the Monetary Conditions Index (MCI) and the broader state of this index, the FCI, for many countries as one of the key indices to determine the state of monetary policy and its effect on the economy. The above economists evaluated this matter by increasing the price of assets, specifically housing and stocks, for Great Britain and Finland. Considering the many discussions about how these variables affect the total demand. In this way, according to the role of asset prices in the money transfer mechanism through wealth and balance effects, many central banks and international institutions have reached the FCI.

Financial conditions are the conditions of financial variables that affect present and future economic behaviour. These financial variables may include anything that determines the supply and demand associated with economic activities. Similarly, it includes a range of asset prices and asset supply and demand indices. Normally, it can be said that the FCI measures financial shocks. This index usually includes interest rate, exchange rate, housing and land price, stock price index, and the weight of these variables.

It is possible to make the financial conditions in different ways:

1. It simulates a wide scale of econometric models and then presents them as a system.
2. Principal Component Analysis (PCA) methodology is a common factor of a group that includes several financial variables.

2. Theoretical foundations and research background

2.1 Effects of monetary policy through the stock market channel

Tobin (1969), in his well-known general equilibrium approach, designed a model that both monetary and financial policies have important effects on asset returns. Based on this approach, the main channel of influencing policies and financial events is the total demand by changing the valuation of physical assets relative to their replacement costs. It should be noted that with an increase in the money supply or with a decrease in the interest rate, the demand for stocks increases, so the price of stocks increases, and in this way, investment expenditures and total demand also increase (Boivin and Giannoni, 2002). The hypothesis of the efficiency of the stock market claims that all coefficients of interruptions of monetary and financial policies should not be statistically significant. That is, all the recent estimates and the estimates made in the past of the expected monetary and financial policy movements will not affect the stock returns because, according to the market efficiency hypothesis, they have already been reflected in the stock returns. Therefore, only the current monetary and financial policy variables coefficients can be statistically significant under the efficiency hypothesis. Also, these coefficients can create new information for the company and individuals in the stock market. This study aimed to examine the first stage of the process. Implementing the monetary policy by the central bank affects a series of intermediate goals or nominal anchors by using the monetary tools to achieve the final goals through them. Interest rate, money volume, inflation rate, and prices are among the most important intermediate goals.

Therefore, monetary policy can directly and immediately affect financial markets, including the stock market, by influencing the return and price of financial assets through its monetary tools and intermediate goals. As a result, it causes stability or instability in financial markets and, consequently, has a positive or negative effect on the real economy.

2.2 Effects of monetary policy through the exchange rate channel

The exchange rate, as a measure of the parity value of a country's national currency against the money of other countries, reflects the economic status of a country compared to other countries. Assuming the full convertibility of all types of money in a country, the exchange rate is an important monetary economy index, greatly affecting all economic fields. Due to its interrelationship with other domestic and foreign variables, the exchange rate is influenced by economic developments inside and outside the country and significantly affects both domestic and foreign economic variables.

Taylor (1993) and Obstfeld and Rogoff (1995) confirmed the importance of the exchange rate channel in the monetary transfer mechanism and emphasized that any framework for applying monetary policy should include international economic relations and areas. Before 1970, the common patterns of determining the exchange rate were based on the level of relative prices and trade flows and the elasticity of currency supply and demand. The extreme fluctuations of the exchange rate in the years after its floating gave economists the idea that these fluctuations were very similar to the asset market price.

From that year onwards, the theoretical literature on determining the exchange rate was directed towards models based on the asset market, where the role of the exchange rate is as the relative price of the national money of countries instead of the price of national products. According to the Dornbusch model, monetary shocks in the short term cause the exchange rate to deviate from the long-term equilibrium. If the volume of money increases, the real supply of money immediately increases, and the interest rate decreases to compensate for the excess supply. A decrease in the interest rate causes capital outflow and an increase in the exchange rate. An increase in the

exchange rate also increases the total demand with a net increase in exports (Dornbusch, 1980).

Based on the exchange rate channel, monetary policy has a greater effect on the export-oriented sector. Most of the revenue of this sector is obtained from foreign markets. Therefore, it will react more to the changes in the exchange rate caused by monetary policies.

Therefore, by applying a contractionary monetary policy, with the increase in the volume of money, the interest rate will decrease, the capital outflow will decrease, the exchange rate will increase, the foreign price of domestic goods will decrease, the value of exports and the total demand will increase.

On the other hand, the exchange rate directly affects the price level of imported goods. Of course, the extent of this effect depends on the elasticity of imports. However, changes in the prices of imported goods, whether they are consumption goods or capital goods, play a large role in determining the general level of domestic prices, affecting production and the level of domestic prices.

2.3 Effects of monetary policy through the interest rate channel

Interest rate is considered the most important change factor in nominal and real variables. In general, the ways of influencing monetary policy on real variables can be divided into interest rates, changes in asset prices, and bank credits.

Keynesians believe that the interest rate is fundamental in transferring monetary policy. This rate is considered the link of communication and transfer of the monetary policy to the real part of the economy; this transfer will reduce the real interest rate in three ways: investment expenditures, adopting an expansionary monetary policy, consequently reducing the cost of capital, and increasing investment and total demand. Also, in the transfer through consumption expenditures of stationarity goods, it is believed that changes in interest rates, in addition to affecting investment expenditures, change the demand for stationarity consumption goods. In the transfer process through the capital account, a change in the interest rate changes capital flows.

2.4 Effects of monetary policy through the credits channel

Timing and combination of monetary policy effectiveness are not possible by relying on traditional theory. Therefore, economists use a set of paths called the credit channel. Different viewpoints are generally based on microeconomic topics, including the role of bad choices, moral hazard, and costly supervision, which affect the nature of credit contracts and equilibrium rationing.

The starting point of this topic is related to the basic assumption that when obstacles such as incomplete information or high-cost contracts interfere with the smooth functioning of financial markets, a gap is expected to form between the cost of funds that are collected from abroad, such as issuing debt instruments, and the opportunity cost of funds raised internally. This gap, which Bernanke et al. (1994) called the cost of foreign financing, reflects the costs faced by firms. Now, accepting the credit channel with the interpretation that monetary policy not only affects interest rates but also affects the amount of foreign financing helps to better understand the composition, timing, and overall effectiveness of the monetary policy.

2.5 Effects of monetary policy through the housing price channel

Housing market developments in Iran's economy have always had a special place, and economists, politicians, and even ordinary people have always paid special attention to this sector. Of course, special attention to this sector has never been without reason. This part of the country's economic system has always made a very large contribution to the country's employment and production. It has been one of the main destinations of economic activists' capital (Mehregan,

2014). Therefore, it is not far from the expectation that the changes in this sector will affect the general state of the economy. By looking at the trend of the variables of GDP growth and the growth of the added value of the housing sector, it is easy to understand that the movement of these two variables is most of the time completely consistent, and it seems that the housing market has played an important role in the business cycles of the economy.

On the other hand, the studies and experiences of the countries have shown that the housing sector is an exogenous part of the economy, contrary to traditional notions, and is affected by other economic variables. In the meantime, after the financial crisis in developed countries, it became clear that monetary policy has a more important role in the housing market and generally affects the market trend (Eickmeier and Hofmann, 2013).

After the financial crisis, attention was turned to the housing sector, and many studies have been conducted on the effectiveness of this sector on other sectors of the economy. Some studies emphasize that monetary policy and the housing market can be a non-linear and asymmetric relationship (Tsai, 2013). The capital or wealth-changing effects of the gainers or losers of housing price increases may be balanced at the aggregate level. If housing is not exchanged internationally, there is no acceptable reason that an increase in the real price of housing causes an increase in the real price. However, there are some conditions under which the positive effects of wealth for owner-occupiers can overcome the negative effects on consumption for future new buyers. The increase in housing prices has an expectation effect and a confidence effect, and optimistic expectations about its future revenue can cause a boom in the housing market.

An increase in the volume of money from the housing price channel leads to an increase in production and price levels only when the money in the housing market is absorbed, and changes in housing supply and demand cause its price to change. In addition to fundamental factors such as population, the number of registered marriages, per capita income, liquidity absorption in the housing market depends on the expected returns from the housing market and other markets, including gold, foreign exchange, stocks, and the money market.

Therefore, if the housing market conditions are favorable and the expected returns are higher, the increased volume of money is absorbed in this market, and the change in housing prices causes an increase in production and price levels. The more the volume of money increases, the less liquidity will enter the housing market. The housing price channel will have a smaller contribution to money transfer to production and price levels because more money will enter the markets with higher returns and affect the housing market less.

2.6 Effects of monetary policies through the volume of money

The viewpoints of different schools differ on how the change in the volume of money affects the real economic variables and the price of goods and assets. However, they all agree that the change in the volume of money, in the long run, leads to a change in the price of goods and assets, including the stock price. Keynesians and monetarists do not agree on what kind of financial assets people replace money when the volume of money increases. Keynesians' view of the effect mechanism can be stated in the following way: they usually consider assets that have fixed revenue (such as bonds and treasury) as a good replacement for money; in other words, in the Keynesian approach, the return of all assets, including stocks, is considered the same and risk-free. The mechanism of effect is such that any increase in money supply through a decrease in interest rates increases the demand for financial assets, including stocks, increasing their prices. In contrast, monetarism argues that an increase in the volume of money will, directly and indirectly, affect the flow of expenditures and asset prices. An increase in the volume of money upsets the equilibrium

between the real balance and the desired balance of the money. There will be excess demand for a wide range of goods and services and financial assets to eliminate the excess supply. On the other hand, they assume that the assets that replace the balance of money are diverse. These include various financial assets with different risks (such as bonds, treasury, mortgages, stocks, etc.). According to monetarism's theory, prices increase directly with increased demand for financial assets, including stocks.

In this research, as we explained above, we explained the effect of the monetary policy on financial conditions through different channels, and in the research method part, we do the same with the Markov econometric method.

2.7 Research background

Researchers have used different methods to construct FCI for many countries and have studied the function of FCI in predicting the inflation rate and the role of monetary policy formulation. For example, *Montagnoli and* Napolitano *(2005)* used financial variables to take weight changes in explaining the production gap and made FCI for the United States, Canada, the Eurozone, and the United Kingdom. Swiston (2008) used the Vector *Autoregression* (VAR) model and Impulse response functions (IRF) to construct the United States FCI and suggested that FCI can predict growth from the real GDP analysis of the United States. Hatzius used principal components to choose the first component, FCI and predicted economic growth using FCI. Gómez (2011) extracted the principal components from the index such as interest rate and exchange rate and obtained the FCI for Colombia using the variance probability from the principal components based on weight. Studies have shown that FCI is an effective tool for accurate macroeconomic regulation using financial component analysis.

Mayes and Viren (2001), who used the reduced aggregate demand equation model in constructing the financial conditions for 17 European countries, stated that the FCI plays a role in guiding the formulation of European countries' monetary policies.

Montagnoli and Napolitano (2005) have used the Kalman refinement algorithm to obtain the change in the weights of the financial variables in explaining the production gap and have made the FCI for the countries of the United States, Canada, Europe, and the United Kingdom. Swiston (2008) used the VAR model and IRF to construct the US FCI and stated that this index can predict the real GDP growth of the US. Hatzius (2010) used the PCA method to choose this index as the first component and predicted economic growth with this index. Gómez (2011) extracted the main factors of indices such as interest rates, exchange rates, and asset prices, and using the variance probability of the main components as weights, he made an FCI for Colombia. Studies have shown that the FCI has been an effective tool for macroprudential regulation and financial stability.

Chinese researchers generally study the ability of the FCI to predict economic growth and inflation and also focus on the probability of using the FCI in monetary laws and policies.

Gauthier et al. (2004) examined the FCI based on the VAR model and factor analysis method from 1981-2000. The main finding shows that the FCI is a better index than the MCI.

Swiston (2008) examined the effect of the FCI on macroeconomic variables. Using the explanatory variables of standard loans, stocks, exchange rates, and partnership bonds, he found that most monetary policy effects affect the credit supply.

Hatzius et al. (2010) concluded that the FCI shows the effect of financial conditions on economic growth.

Vonen (2011), in the article FCI for Norway, examined the relationship between financial conditions and economic variables using the factor analysis method. Using the monthly data of exchange rates, stocks, housing prices, credits of financial firms, and credits of commercial banks,

he concluded that economic growth could be predicted using financial conditions.

Ho and Lu (2013), in an article entitled FCI for Poland, using the factor analysis method and VAR model, concluded that the FCI is related to GDP growth and is better in the short term.

Taylor (1993) showed that the change in macroeconomic performance depended on the change in adherence to monetary rules and the practical independence of the Central Bank. Also, the monetary policy of the Central Bank of America in the absence of monetary rules led to unemployment and high inflation.

Taylor (1993) showed that the deviation from the regular policies that worked well during the period of prosperity without inflation had been a factor in the deviation of macroeconomic performance in recent years in the American economy.

Manning and Shamlou (2015) examined the effect of monetary policy on business variables using the factor analysis method and VAR model. Their findings show that the FCI is a suitable tool for economic growth.

Polat et al. (2015) show that financial development drives economic growth. The capital increase causes economic growth, but trade openness prevents it.

Taghizadeh et al. (2016) measured the FCI and the MCI using the PCA method. Using two different periods is one of the weaknesses of this research because at least 30 periods of information are required, which was not observed in this research.

Atrkar and Mahboobi (2016), by estimating the total retrospective supply and total demand functions, concluded that during the studied period, the housing price variable (asset price variable) in the target index had a higher weight than other variables, while the effect of the coefficient of the stock index was not significant on the national production gap in any of its gaps. The findings of the research also indicate that the target index has the power to predict inflation in Iran's economy.

Mohseni et al. (2019) estimated the effect of the FCI on the activities of Iran's economy using seasonal data from 2006-2017. Then, the FCI's immediate action and reaction variables were estimated using the prior and posterior distribution in the Bayesian VAR model. Their research findings indicate that the FCI had a negative effect on the GDP and private sector investment, and credit growth played an important role in the FCI.

Dadgar and Nazari (2013) showed that a relative improvement in financial development is observed whenever the financial and economic standards are paid attention to. An increase in the share of non-governmental banks in the banking industry, an increase in the share of the private sector in bank credits, a decrease in concentration in the banking sector, and an increase in the ratio of facilities granted to non-government sector deposits can be mentioned among the factors of relative improvement in financial development in the country. Also, the liquidity-to-GDP ratio, used in many studies as a financial depth index, has been increasing in recent years. In order to achieve a favorable level of financial development in the coming years, the country needs to formulate a standard plan for financial development, pay attention to institutional reforms and create the necessary infrastructure to improve the institutional environment.

Sharifi Nia and Haghighat (2023) concluded that one of the most important economic tools that affect various economic variables through different channels and with different speeds and intensities has always been the attention of the responsible authorities of countries, especially developing countries like Iran. On the other hand, banks, as financial and credit institutions with a special place in the country's economy, play a decisive role in the circulation of money and society's wealth.

Zareinejad et al. (2022) concluded that by using the Markov switching method in the regime of one credit channel and the regime of two channels, housing and stock prices had the greatest role in transmitting the effects of money on inflation.

3. Research methodology

3.1 Data collection

This research data was collected and prepared from the Central Bank website. The variables used in this research are from 1991 to 2023. The type of data also includes time series. Factor analysis, as opposed to multiple regression, is a diagnostic analysis or focal correlation in which there are one or more dependent variables and several independent variables. In this technique, the studied variables are considered interdependent and categorized based on their correlation and relationship in the form of a set of factors.

The main goal of factor analysis is to purify a large number of variables in a limited number of factors so that there is the least amount of lost information in this process.

There are various models in factor analysis, among which two methods are PCA and common factor analysis. The PCA model is used when the researcher aims to purify the variables and achieve a limited number of factors. In contrast, common factor analysis is used when the goal is to identify factors or dimensions that are not easily recognizable (Ibid).

3.2 PCA method

PCA is a well-known and widely used method to reduce data dimension. The PCA method can convert some dependent variables into a smaller number of independent variables using mathematical relations. These new variables or features are called principal components. The purpose of the PCA method is to find the hyperplane on which the data image is most similar to the principal data. PCA is a transformation in the vector space that produces the greatest dimensionality reduction in the data set used. This method includes analyzing the eigenvalues of the covariance matrix of the data set. Experience has shown that feature transformation in the form of the PCA method, in most cases, leads to an increase in the accuracy of the learning model. However, this method also has limitations. One of the main applications of PCA is feature reduction operations. As its name suggests, it can identify the main components and help us analyze a series of more valuable features instead of examining all the features. PCA extracts those features that provide more value.

3.3 Markov switching model

The Markov switching model is suitable for explaining the behavior of variables that change direction continuously, and their behavior changes from one state to another and returns to the previous state. The novel feature of the Markov-switching model is that the regime change mechanism depends on a state variable following a first-order Markov chain feature. This feature completely contrasts with a model such as the *quantum* stochastic model, where regimes are independent of each other over time. The markov-switching model is also different from structural change models. In the Markov model, changes are allowed at any point in time and number of times, while in structural change models, it is only possible to apply changes at certain times and exogenously. Therefore, the Markov switching model is suitable for explaining data that show different behavioral patterns in various periods. Today's economies have a common feature: economic activities are moving from a period of prosperity in which there is economic growth to a period of stagnation in which economic activities have negative growth.

In Markov rotation models, the behavior of the variable yt, in addition to εt and independent variables, depends on the state variable st. Due to the change of regime over time and the difference of parameters in the models related to each regime, the conditional mean values of the variable yt, the disturbance component related to each regime, and the variance of the model related to each

regime can be different. Therefore, assuming that εt follows a normal distribution with zero mean and variance $\sigma 2(st)$, the probability of yt occurring in different regimes is as follows:

$$f(yt|st,\Omega t-1)=1/\sigma(st)\sqrt{2\pi}\exp(-(yt-\Phi(st)2\ /\ 2\sigma 2(st))$$

Where $\Phi(st)$ and $\sigma 2(st)$ are the conditional mean and variance of the variable yt, respectively, both of which follow the state variable st. Therefore, the probability of the occurrence of the random variable yt at any point in time will depend on the random, latent st and dependent variables. Considering that the distribution st depends on its past values, in other words, the probability of occurrence st is not independent; there is a common probability between the occurrence yt and all st (($yt|st$, $\Omega t-1$). Based on this feature and the property of maximum likelihood functions based on maximizing the probability of co-occurrence of random quantities in the sample to maximize the probability of occurrence of the examined sample in the statistical population, these functions can be used to estimate all the random quantities of the model that are specified are not; therefore, we can write:

(3-1)

$$L=(yt|st=j,\Omega t-1)=\sum\sum(yt|st,\Omega t-1)p(st=j|st-1=i,\Omega t-1)$$

As stated in the above equation, st is a random variable that follows the Markov chain with the transition matrix $\{st=j|st-1=i\}$=pij. Also, the disturbance term εtr is an uncorrelated random variable with mean zero and normal distribution and as εtr~(0,$\sigma r2$). In this regard, in the next section, we will first introduce two policy rules to examine the performance of monetary policy and financial leverage on the growth rate of private sector credits. Then, to estimate both policy rules, firstly, the test of how to specify the model and check whether the model is linear versus non-linear have been examined. If the model parameters are shown from a non-linear process, using a linear model will lead to misleading results and vice versa.

The maximum likelihood method is used to estimate the Markov switching model. Therefore, the likelihood logarithm function can be written as the following equation:

(3-2)

$$L=\sum_{t-1}^{T} \text{Log}\ (P_{1,tf(FDI:\ St=1+(1-P_{1,t})f(FDI:\ St=2)}$$

So that f(FDI: St=i) is the conditional distribution of the FCI to condition regime i at time t (The symbol : indicates the condition that)

On the other hand, considering that regime changes in these models accompany the studied time series, the assumption of constant parameters in VAR models is not justified.

The complete Markov switching model in the following equation, where the mean and variance are dependent on regimes (three regimes), can be stated as follows:

(3-3)

$$Y_t-\mu_s=A_1S_t\left(Y_{t-1}-\mu S_{t-1}+\cdots+A_p\,(S_t)\left(Y_{t-p}\right)-\mu\left(S_{t-p}\right)\right)+\varepsilon_t\ ($$

Yt, μ, Ap(to A1), and εt are the time series vector, mean vector, model parameters vector, and model residuals vector, respectively, which have a normal distribution (Krolzeig, 1997).

Considering that St is a random variable and its changes cause changes in the equation's structure, it is better to identify how the state variable St changes. Therefore, in MS models, it is assumed that the state variable follows the first-order Markov chain, in which the current regime is dependent on the regime of the previous period and is as follows:

(3-4)

$$(P_r(S_t = j \vdots S_{t-1} = i, S_{t-2} = K, \dots) = P_r(S_t = j \vdots S_{t-1} = i) = P_{ij}$$

4. Findings

4.1 Stationarity test of variables and their results

The variables should be checked before estimating the stationarity model. This work helps to ensure that the results of estimations are not falsified; the non-falsity of regression is studied in different ways. This research used the augmented Dickey–Fuller (ADF) test to check the variables' stationarity. The test results are shown in Table (1).

Table 1. Phillips-Perron test with Intercept mode and time trend at 0.05 level for all variables

Test result	PP statistics	Critical value	Variables
Non-stationarity	-2.400	-3.560	IRD
Non-stationarity	-0.860	-3.560	EXR
Non-stationarity	-1.440	-3.560	LOAN
Non-stationarity	-3.510	-3.560	BSC
Non-stationarity	0.740	-3.560	STOKE
Non-stationarity	-2.160	-3.560	LHPHA
Non-stationarity	-1.230	-3.560	M2

Source: Research findings

According to the results, it has been determined that all research variables are non-stationary. Therefore, the ADF test was conducted with one time difference for all research variables.

Table 2. Phillips-Peron test results with a one-time difference

Test result	PP statistics	Critical value	Variable
Stationarity	-5.400	-1.950	IRD
Stationarity	-3.080	-1.950	EXR
Stationarity	-5.300	-1.950	LOAN
Stationarity	-9.800	-1.950	BSC
Stationarity	-3.500	-1.950	STOKE
Stationarity	-5.550	-1.950	LHPHA
Stationarity	-4.200	-1.950	M2

Source: Research findings

According to the results of Table (2), all the research variables were non-stationarity, with a one-time difference; all were stationarity at 0.05. It is worth mentioning that using different variables causes the loss of information about the main values of the variables. To solve this problem, the cointegration test is proposed. Therefore, Johanson and *Juselius's* (1990) cointegration test is used to check the cointegration of the model. Null hypothesis means no cointegration. Based on the results of this test, the presence of cointegration at the 0.05 level has been confirmed. Therefore, the null hypothesis of no cointegration is rejected. The results of this test are shown in Table (3).

4.2 Cointegration test

It is worth mentioning that using different variables causes the loss of information about the main values of the variables. To solve this problem, the cointegration test is proposed. Therefore, the Johansen and Juselius (1990) cointegration test is used to check the cointegration of the model.

Null hypothesis means no cointegration. Based on the results of this test, the presence of cointegration at the 0.05 level has been confirmed. Therefore, the null hypothesis of no cointegration is rejected. The results of this test are shown in Table (3).

Table 3. The results of the Johanson and *Juselius* cointegration test

Maximum eigenvalues test	Effect test	Relations
111.6 (0.000)	386 (0.000)	No relation
93.500 (0.000)	274 (0.000)	Maximum of one relation
70 (0.000)	181 (0.000)	Maximum of two relation
58 (0.000)	110 (0.000)	Maximum of three relation
37 (0.000)	51 (0.000)	Maximum of four relation

Source: Research findings

Before calculating the FCI using the factor analysis method (PCA method), the KMO and Bartlett tests must be used to ensure the adequacy of the chosen sample.

Performing calculations related to factor analysis requires a large amount of data. These two tests are scientific methods to ensure the adequacy of the chosen sample. The sample size must be adequate before using the factor analysis (PCA) method. The sample size is a determining factor in the accuracy of element clustering with the factor analysis method. One of the methods to check sample adequacy for factor analysis is to calculate the sample adequacy index. Kaiser, Meyer, and Olkin invented the sampling adequacy index, denoted by the symbol KMO. This index should be between 0.5 and 0.7, as shown in Table (4).

Table 4. KMO and Bartlett test results

KMO statistics	0.500
Chi-square statistic (Bartlett's test)	295.200
Probability	0.000

Source: Output of SPSS software

According to the obtained statistic (0.5), its value is almost acceptable and indicates the adequacy of the sample size for the research.

According to the theoretical foundations and what was said about the FCI, this index can be written as an equation as follows:

$$FCIt = \omega \text{ ir } (ir_t) + \omega exr\ (\ exr_t\ ) + \omega \text{BAL } (BAL_t) + \omega stock\ (stock_t) + \omega \text{ LAHPA}(LAHPA_t)$$

Where FCI, irt, exrt, lent, and BAL represent the FCI, the real interest rate at time t, the real exchange rate at time t, the bank lending channel for the facilities of banks and credit institutions, and the balance sheet channel (net foreign assets of the banking system in billions of Rials), respectively; and stocht and LAHPA represent the asset channel, where stockt is the stock market index and LAHPA is the land and housing price index) of all urban areas.

Table 5. The results of the PCA for calculating the FCI

		Eigenvalues: (Sum = 7, Mean = 1)					
		No.	**Value**	**Difference**	**Proportion**	**Cumulative value**	**Cumulative proportion**
		1	3.600	1.470	0.510	3.600	0.510
		2	2.130	1.520	0.300	5.740	0.820
		3	0.610	0.220	0.080	6.380	0.900
		4	0.380	0.230	0.050	6.750	0.960
		5	0.150	0.100	0.020	6.910	0.980
		6	0.050	0.020	0.008	6.960	5
		Eigenvectors (loadings)					
number	**variable**	**Pc1**	**Pc2**	**Pc3**	**Pc4**	**Pc5**	**Pc6**
1	loan	0.380	-0.310	0.440	-0.230	0.630	0.280
2	lhpa	0.490	-0.170	0.060	0.290	0.030	-0.680
3	ird	0.390	0.220	-0.560	0.510	0.280	0.030
4	bsc	0.430	0.260	-0.190	-0.520	-0.260	0.290
5	stoke	0.010	0.560	0.630	0.420	-0.100	0.220
6	exr	0.160	0.620	0.020	-0.360	0.020	-0.450

Source: Research findings

According to the calculation coefficients in the first vector mentioned in Table (5), it can be said that the highest correlation with the first components is, respectively, the variables of land (housing) price index, amount of liquidity (volume of money), net foreign assets of the central bank, interest rates, facilities granted by banks, exchange rates and stock price index.

The first component is the best choice because, as it shows, the first component is greater than one, and this component explains about 51% of the dispersion of the data set. In other words, this criterion shows that the choice of the first component (the first vector) is adequate, and the FCI is obtained.

The first vector is chosen for the above reasons and is called PC1 in the computer outputs. It can be considered an FCI and used in various econometric models. By choosing this vector, the linear combination of the first component or PC1 and the main variables according to Table (5), is as follows.

$$FCI= 0.38\ Loan+ 0.49\ LhPA+ 0.39\ IRD+ 0.43\ BSC+ 0.01\ Stoke+ 0.16\ EXR$$

Housing is widely related to economic activities from the point of view of influencing employment and production and creating dynamism and mobility in the economy. Periodic changes in demand, price, and investment in the housing market and the resulting fluctuations in the financial and economic markets have affected the owners of these assets and investment.s

Therefore, housing is a tangible and objective asset of particular importance in creating added value, creating jobs, using internal inputs, and creating internal links between economic sectors. In the research, housing has the most weight in calculating the FCI.

The central bank's net foreign assets are the second significant variable in the FCI calculation. There are two reasons for the increase in the net foreign assets of the central bank. The change in the parity rate of the Rial against other currencies and the increase in the value of the gold price in the Rial due to the decrease in the value of the national currency can be the first reasons for the increase in net foreign assets. The second reason can be the purchase of the government currency or the currency of the National Development Fund by the central bank. According to the monetary and banking law, the central bank is required to buy government currency, and this issue increases the currency balance of the central bank and increases liquidity.

The interest rate is the third variable contributing to the calculation of this index. Interest rate is one of the macroeconomic factors and is important in any country. The central bank determines the interest rate based on the economic conditions and conducts financial and banking affairs in line with this rate. The interest rate is used to prevent the devaluation of the money for the lender between paid money today and received in the future.

The fourth variable that effectively calculates the FCI is the facilities granted by banks (bank loans). The specific role of banks as lenders to classes of bank borrowers will increase loans that will increase investment expenditures. Therefore, the implementation of expansionary monetary policies by increasing the number of bank deposits has led to an increase in the number of bank resources and an increase in the amount of lending by banks, and this has led to the injection of bank resources into various economic sectors through loans and payment facilities that it will ultimately lead to an increase in the prosperity of production and economic growth.

The fifth variable that affects the FCI is the exchange rate. The effects of the exchange rate on real production in the economy are evident. Exchange rate changes affect inflation and the increase in the prices of goods faster than production. Therefore, with increased prices and revenue, producers are encouraged to produce. Fluctuations in the exchange rate affect the country's production and demand growth, so choosing appropriate currency policies according to the economic conditions leads to establishing a suitable currency system.

If the exchange rate can change, the prices in the economy may change more quickly. These fluctuations are defined as instability and uncertainty and are considered a measure of risk, illustrating the uncertainty in international transactions of financial goods and assets.

The last and sixth variable affecting the FCI is the stock index. The degree of development of financial markets, i.e. (the total value of transactions and return on equity), leads to greater effectiveness of the capital market in economic growth. Most studies are related to the relationship and role of financial markets, especially the capital market, in financing and economic growth. The capital market is summarized in two basic functions; the first function is the providing long-term financing of firms by directing savings resources with the aid of tools such as stocks, bonds, and other tools, and the second function is risk management by providing risk-covered strategies in financial markets or actual sector activities of the national economy. Today, countries are growing in their economy, pioneering in implementing new financing strategies. Economies with a relatively advanced financial market, the capital market (stocks and bonds, etc.), play a multiplier role in firms' financing. The stock market not only provides information available to everyone, in addition to providing more financial options for firms in search of resources, but it also provides important signals to help allocate resources and thus contribute to calculating the country's financial conditions.

4.3 Linearity LR test in research data

The most important part of the reported results is related to the Linearity LR test, which is used to determine the suitability of the non-linear model against the linear model. In fact, with this test, it can be understood whether the non-linear model has been able to add to the explanatory power of the model compared to the linear model.

The likelihood ratio test has been used to determine the relationship between variables. This test is defined as a chi-square distribution according to parameters. The null hypothesis is the absence of regime transition in the model. If the null hypothesis is rejected, it indicates a non-linear relationship between the variables, which occurs when the degree of freedom of the distribution is equal to the number of disturbance parameters plus the number of applied linear limitations.

In this test, the null hypothesis is the equality of the means, and hypothesis 1 is the inequality of

the means and the nonlinearity of the model. Now, suppose the value of the statistic obtained is greater than the critical value of the chi-square distribution at the 95% level. In that case, the hypothesis of the linearity of the model can be rejected, and it can be concluded that the non-linear model has more explanatory power than the linear model.

Table 6. LR test results

LR test statistics	The value of the probability
42.080	0.000

Source: Research findings

Based on the research results in Table (6) and considering that the value of the LR statistic is equal to 42.08 and the significance level of the DAVIS statistic is less than 0.05, a non-linear relationship between the variables is confirmed. Therefore, multi-regime Markov switching models should be used instead of single-regime linear models.

The chosen model with the lowest limit of the Akaike criterion, MSIAH (2) AR (2) mode, was chosen from among the different modes of the Markov switching model, which is summarized in Table (7).

Table 7. MSIHA (2) AR (2), Markov switching model estimation results

Variables	**Regime zero**			**Regime one**		
	Coefficient	**T statistics**	**The value of the probability**	**Coefficient**	**T statistics**	**The value of the probability**
Intercept	-6.640	-30.000	0.000	11.470	3.470	0.010
Volume of money	0.270	5.100	0.000	0.420	2.680	0.030
Loans and facilities granted by banks	0.140	0.230	0.000	0.015	0.750	0.000
Land and housing price	0.630	11.000	0.000	0.050	5.820	0.000
Bank (short-term) deposit interest rate	0.050	0.395	0.000	0.270	593.000	0.000
Net foreign assets	0.090	0.690	0.000	0.055	0.395	0.000
Stock price index	0.010	0.226	0.000	0.220	0.953	0.000
Exchange rate	0.440	4.160	0.004	0.110	434.000	0.000
The first interruption of FCI	0.360	2.040	0.000	0.100	0.700	0.000
The second interruption of FCI	0.020	0.087	0.000	0.080	0.843	0.000
Standard deviation	0.020	0.005	0.000	0.230	0.039	0.000
Akaike criterion			-5.560			
Maximum likelihood			17.050			
Likelihood ratio (LR) test			*The value of the probability: 0/0* *T statistics value: 42.08*			

Source: Research findings

The estimations of the parameters related to the model indicate that the studied period can be separated into two regimes of zero and one so that the intercept is equal to -6.64 in regime zero and 11.47 in regime one. Considering that in Markov switching models, the regime with negative intercept is the regime with low efficiency and the regime with positive intercept is the regime with high efficiency, based on this, regime zero can be called a regime with low efficiency, and regime one can be called a regime with high efficiency. On the other hand, the coefficient of the first interruption of the FCI has a positive and significant effect on the monetary policy in both regime

zero and regime one. So, a 1% increase in the FCI in regime zero will lead to a %0.02 return of the FCI in the next month and a %0.36 increase in the next two months. In addition, the increase in the FCI in regime one will lead to a 0.08% return of the FCI and a %0.10 increase in the next two months.

In addition, the volume of money in regime zero and regime one also positively and significantly affects financial conditions. Therefore, the liquidity has positive effects on the FCI. This means that a %1 increase in liquidity, %0.27 in regime zero, and %0.42 in regime one positively affected the FCI in this research period. According to the views of different schools regarding how the change in the volume of money affects the economic variables and the price of goods, they all agree on one issue: the change in the volume of money leads to a change in the price of goods and assets, including stocks. Monetarism argues that the increase in the volume of money will directly affect the flow of expenditures and asset prices. In addition, the volume of money and its growth affects economic activities, emphasizing important variables such as production and employment. On the other hand, with the implementation of expansionary monetary policies, the volume of money in society increases, and it is a tool for the continuation of economic prosperity and GDP.

Loans and facilities granted by banks in both regimes zero and one have a positive and significant effect on the FCI, so with a 1% increase in bank facilities (bank loans), the FCI increases by %0.14 in regime zero and %0.15 in regime one. Because an efficient financial and banking system transfers capital from savers to recipients of bank facilities, productive financing projects increase production and economic growth. On the other hand, banks have influenced economic growth by providing the resources needed for real investment. The role of finance in terms of bank credits includes the channel of budget transfer from the deficit unit of the economy as a result of converting deposits into loans or credits (Adini, 2006). The obtained bank credits enable various economic factors to invest operational costs because bank credits provide a way to create and maintain a proper business. By collecting surplus resources, the banking sector helps make credits available to investors with brilliant ideas but lacking the capital to implement them (Adamou, 2006). The bank has a facilitating role for innovations and implements this role by providing credit to production sectors. Therefore, bank facilities can lead to successful investment and ultimately be effective in economic development and improvement of financial conditions.

The land and housing price variable has positively affected the FCI in regime zero and regime one. So, in regime zero, with a 1% increase in housing prices, the FCI increases by %0.63. In regime one, with a 1% increase in the price of housing and land, the FCI increases by %0.05. When an expansionary monetary policy is established, the demand for housing is stimulated and causes an increase in housing prices, which, according to the life cycle model, a permanent increase in housing wealth leads to an increase in household expenditures. The effect of wealth caused by the change in housing prices is an important channel in the money transfer mechanism. When the price of housing increases, it leads to an increase in the net value of housing, which can strengthen consumption. In general, liquidity is an important variable in increasing housing prices. Therefore, a sharp increase in liquidity leads to a sharp increase in housing prices and the emergence of severe disturbances in allocating economic resources. Therefore, if the capital market is inefficient and cannot absorb liquidity, the probability of its transfer to other asset markets such as housing, currency, and gold and creating a shock in these markets will arise (Arbabian et al., 2019).

The bank deposit interest rate variable in Regime Zero and Regime One significantly and positively affects the FCI. Thus, in regime zero, with a 1% increase in the deposit interest rate, the FCI increases by %0.05, and in regime one, with a 1% increase in the interest rate, the FCI increases by %0.27. Based on McKinnon- Shaw theory, the increase in the bank interest rate can

conclude that by increasing the interest rate of bank deposits, the investment amount will increase, ultimately leading to an increase in investment and growth. Therefore, increasing the interest rate on deposits will reduce inflation. On the other hand, the interest rate must be higher than the inflation rate; otherwise, part of the assets and purchasing power of the depositors will be lost, which means a decrease in consumption, a decrease in demand, and a decrease in investment. The increase in the deposit interest rate makes investments directed toward user technologies. Also, the bank interest rate affects the amount of capital accumulation in the country, employment, and consequently, production by influencing investment in the private sector. On the other hand, in the monetary sector of the economy, the real and financial assets market is directly and indirectly affected by the bank interest rate, and the fluctuations of these two markets also affect inflation.

The stock price index variable is another variable that monetary policy affects financial conditions through this channel. The effect of the stock index on financial conditions is positive and significant, so in regime zero, a 1% increase in the stock price index increases the FCI by %0.018. In regime one, with a 1% increase in the stock price index, FCI increased by %0.22. This result is consistent with economic theories because one of the most important topics in theoretical economics is how the capital market affects the consumption expenditures of the private sector. A boom in the stock market can increase consumption expenditures. Because according to theories, consumption depends on the present value of lifetime revenue, and stocks represent a part of wealth. Therefore, an increase in wealth (stock market) can lead to an increase in the growth of consumption expenditures. As stocks and bonds rise, people feel rich and their consumption expenditures increase. In addition to affecting consumption, stock fluctuations can also affect investment expenditures. In fact, with the increase in stock prices, firms are encouraged to use new structures and equipment, and as a result, their total capital stock increases. Also, stock price as a part of assets can affect inflation through inclusion in expenditures. For example, an increase in asset prices through the effect of the balance sheet can increase the borrowing power of individuals and firms through collateral. The increase in the net value of assets increases the willingness of lenders to lend. Increasing the value of assets facilitates the development of public expenditures and expenditures in construction.

The exchange rate is another variable that affects financial conditions through this channel. This variable has a positive and significant effect on financial conditions. A 1% increase in the exchange rate increases the financial conditions by %0.44 in regime zero and %0.11 in regime one so that the exchange rate can affect the amount of investment in different sectors of the national economy by influencing intermediate and capital goods and imported and exported raw materials. With the change in Rial and dollar prices of raw materials of intermediate and capital goods, the first effect is seen in the prices and costs of production, which affects the production of domestic and foreign goods. On the other hand, the exchange rate affects the competitiveness of the countries that are parties to trade agreements and the export and import of consumption goods. In this way, it can provide the basis for reducing and increasing the price index. Since the real exchange rate is affected by the supply and demand of a currency in the currency market, monetary authorities can help strengthen the national money by using oil currency. With the increase in the exchange rate, consumption expenditures are transferred from foreign goods to domestic goods, and with the increase in exports and decrease in imports, the trade balance improves. This policy reduces the balance of the payment gap through export growth. In the framework of Keynesian economics, if the exchange rate can improve the net export and the balance of payments, it will affect the national revenue expenditure proportional to the multiplier coefficient.

The net foreign assets of the central bank have had a positive and significant effect on the FCI both in regime zero and in the regime so that in regime zero, with a %1 increase in the net foreign

assets of the central bank, the FCI increases by %0.09. In regime one, with a 1% increase in the net foreign assets of the central bank, FCI increased by %0.05. Whenever the central bank's net foreign reserves increase, the central bank's net claims from the public sector increase, or the central bank's claims from banks increase, it causes an increase in the monetary base and the amount of liquidity. Also, when people's desire to keep banknotes decreases and they do more of their transactions with banking tools when people's desire to keep long-term non-visual and permanent deposits increases, or when the central bank imposes a lower legal reserve rate, or when the banks and credit institutions are less cautious in keeping reserves, then the ability of banks to lend and create money will increase (the multiplier coefficient of liquidity creation will increase) and the amount of liquidity will increase. In other words, we call the amount of liquidity to the monetary base ratio as the multiplier coefficient of liquidity creation, and it indicates that for each Rial of money created by the central bank, a few rials of liquidity have been created. The important point in the presented analysis is the relatively endogenous process of money creation, which limits the power of the central bank to control the growth of the monetary base. One of the issues raised is that the ratio of monetary quantities to GDP (for example, the amount of liquidity to GDP ratio) in Iran is much lower than in many other countries, and this means that higher economic growth can be achieved by increasing the amount of liquidity and directing it towards production. After estimating the optimal Markov switching model, it is necessary to interpret the transition probability matrix. In this matrix, the elements of the primary diameter indicate the regime's stability and the elements of the secondary diameter indicate the probabilities of regime change. Table (8) reports the obtained observations.

Table 8. Results of transition probability matrix and stability of regimes in the estimated two-regime Markov model

	Regime zero and period t	**Regime one and period t**
Regime zero and period t+1	0.836	0.112
Regime one and period t+1	0.163	0.887

Source: Research findings

As can be seen, for example, if the FCI is in regime zero in period t, there is a probability of 0.83 that it will be in regime zero in period t+1, and with a probability of 0.16, it will be transferred in regime one in period t+1. However, suppose the FCI is in regime one in period t. In that case, there is a probability of 0.88 that it will also be in regime one in period t+1, and it will be transferred to regime zero in period t+1 with a probability of 0.11. Therefore, the above table shows that the stability of regime one is higher than that of regime zero. The same was observed in the above Table (8), and in the model estimation, it was observed that regime one was a regime with higher efficiency.

An important issue in the topic of Markov models is that the disturbance term must be normal and free from autocorrelation and heterogeneity of variance. Table (9) shows the results of the related tests.

Table 9. The results of the relevant tests of the Markov switching model

Test statistic value and probability value	Test statistics	Test type
0.652 (0.721)	Chi2(2)	Autocorrelation test
1.004 (0.605)	Chi2(2)	Normality test
0.715 (0.436)	F(1,5)	ARCH homogeneity variance test

Source: Research findings

According to the results of the non-autocorrelation test, normality and homogeneity variance can be seen. The error level is above 5%, and it can be expanded that the disturbance terms have no autocorrelation, the error terms are normal, the model does not have heterogeneity of variance, and the Markov switching model can be confirmed.

5. Conclusions and policy suggestions

In this part, using the time series data extracted from the time series data bank of the Central Bank, the FCI uses data including interest rate, exchange rate, net foreign assets, stock price index, land and housing price index, and the FCI was calculated with the PCA method. Then, the effect of monetary policy using different channels of money volume, stock price index, net foreign assets, housing price index, bank deposit interest rate, and exchange rate, the effect of this important economic policy on the FCI using Markov switching economics method was measured.

The results of estimating the FCI with the PCA method show that the interest rate has a positive and significant effect on the FCI; its weight in measuring the FCI is positive, and its value is 0.39. The exchange rate channel also has a significant effect on the FCI because, first of all, the effect of the exchange rate on the measurement of the FCI has become positive and because the effects of the exchange rate on real production in the economy are evident. Exchange rate changes affect inflation and the increase in the prices of goods faster than production. Therefore, with increased prices and revenue, producers are encouraged to produce. Fluctuations in the exchange rate affect the country's production and demand growth, so choosing appropriate currency policies according to the economic conditions leads to establishing a suitable currency system. The value of this coefficient is 0.16 when determining the measurement of the FCI. The stock price index has a positive and significant effect on the FCI. The value of the stock index has also become positive and 0.01 because the degree of development of financial markets, i.e. (the total value of transactions and return on equity), leads to greater effectiveness of the capital market in economic growth.

The land and housing price channels have positively and significantly affected the stock price index. The value of this channel is positive and 0.49. According to the theoretical foundations of the research, this result was not far from expected because housing has a wide relationship with economic activities from the point of view of influencing employment and production and creating dynamism and mobility in the economy. Periodic changes in demand, price, and investment in the housing market and the resulting fluctuations in the financial and economic markets have affected the owners of these assets and investments.

Loans and bank facilities have a positive and significant effect on the FCI because the value of this variable is 0.38 and has become positive. The specific role of banks as lenders to classes of bank borrowers will increase loans that will increase investment expenditures. Therefore, the implementation of expansionary monetary policies by increasing the number of bank deposits has

led to an increase in the number of bank resources and an increase in the amount of lending by banks, and this has led to the injection of bank resources into various economic sectors through loans and payment facilities that it will ultimately lead to an increase in the prosperity of production and economic growth.

Net foreign assets have a positive and significant effect on measuring the FCI; its value is positive and 0.43 because, as mentioned, there are two reasons for the increase in the net foreign assets of the central bank. The change in the parity rate of the Rial against other currencies and the increase in the value of the gold price in the Rial due to the decrease in the value of the national currency can be the first reasons for the increase in net foreign assets. The second reason can be the purchase of the government currency or the currency of the National Development Fund by the central bank. According to the monetary and banking law, the central bank is required to buy government currency, and this issue increases the currency balance of the central bank and increases liquidity.

Monetary policy through the interest rate channel has a positive and significant effect on the FCI because the bank deposit interest rate variable, both in regime zero and regime one, has a significant and positive effect on the FCI. Thus, in regime zero, with a 1% increase in the deposit interest rate, the FCI increases by %0.05, and in regime one, with a 1% increase in the interest rate, the FCI increases by %0.27. Based on McKinnon-Saw's theory, the increase in the bank interest rate can conclude that by increasing the interest rate of bank deposits, the investment amount will increase, ultimately leading to an increase in investment and growth.

Monetary policy significantly affects the FCI through the exchange rate channel. The exchange rate is another variable that affects FCI through this channel. This variable has a positive and significant effect on FCI, so a 1% increase in the exchange rate increases the FCI by %0.44 in regime zero and %0.11 in regime one. The exchange rate can affect the investment amount in different sectors of the national economy by influencing intermediate and capital goods and imported and exported raw materials. With the change in Rial and dollar prices of the raw materials of intermediate and capital goods, the first effect is seen in the prices and costs of production, which affects the production of domestic and foreign goods.

Monetary policy has a significant effect on the FCI through stock prices. The stock price index variable is another variable that monetary policy affects FCI through this channel. The effect of the stock index on FCI is positive and significant. So, in regime zero, a 1% increase in the stock price index increases the FCI by %0.018. In regime one, with a 1% increase in the stock price index, FCI increases by % 0.22.

Monetary policy through land and housing prices has a significant effect on FCI. The land and housing price variable has positively affected the FCI in regime zero and regime one. So, in regime zero, with a 1% increase in housing prices, the FCI increases by %0.63. In regime one, with a 1% increase in the price of housing and land, the FCI increases by %0.05. When an expansionary monetary policy is established, the demand for housing is stimulated and causes an increase in housing prices, which, according to the life cycle model, a permanent increase in housing wealth leads to an increase in household expenditures.

Monetary policy significantly affects the FCI through the volume of money. The volume of money in regime zero and Regime One also positively and significantly affects FCI. Therefore, the liquidity has positive effects on the FCI. This means that a 1% increase in the amount of liquidity, %0.27 in regime zero, and %0.42 in regime one positively affected the FCI in this research period. According to the views of different schools regarding how the change in the volume of money affects the economic variables and the price of goods, they all agree on one issue: the change in the volume of money leads to a change in the price of goods and assets, including stocks.

In choosing the monetary policy tool for the country's economic growth, the central bank must be careful because, in the form of equilibrium, a tool may not have the right effects if used incorrectly.

Banks can invest term deposits in economic projects, so if this does not happen, it will cause inflation and increase exchange rates through speculative activities.

The government must also be careful in choosing the combination of monetary and financial policy because if the government's policies do not succeed, it will eventually lead to inflation and an increase in the exchange rate. For example, the combination of construction costs or the net capital cost, which, if not optimal, leads to a large inflationary burden, such as the Mehr housing project in 2012 and 2013.

The central bank's independence can positively affect economic growth; therefore, policymakers should consider providing the necessary legal and political conditions to increase the central bank's independence. Also, monetary policy in Iran can affect economic growth. Therefore, it is suggested that central bank policymakers consider the effects of monetary policies before applying them. On the other hand, it can be said that central bank policymakers should avoid momentary decisions because any monetary policy can cause macroeconomic variables to fluctuate, which will reduce economic growth.

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Analyzing Board Network in Iran's Capital Market

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Abstract

This research analyzes the board network of the companies in Iran's capital market from 2019 to 2022. The research results indicate that despite the difference in the level of communication, most units are related to each other. However, some units are in a better position to establish this relationship. Even in the communication network, there is a gap between the positions of the units and the difference between them becomes considerable, creating a class structure. The better position of some units has caused them to encounter fewer mediators in gaining access to other units, to have faster access, and to have a higher ability to gain access to information through the cluster of network members. In addition, some units are on the communication path of other units, so they have a power of influence. Since these units are in the flow path of information, they have more accessible and faster access to information. These units can play the role of key actors in the governing structure.

Keywords:
Board, Iran's Capital Market,
Network Analysis

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1. Introduction

According to theorists studying agency theory, corporate governance is considered a systematic provision that provides some degree of control over agents' actions, such as managers and subcontractors (Marie L'Huillier, 2014). It guides businesses to operate ethically and responsibly. This notion has evolved due to economic, social, and legal changes. Companies can continuously create value for their stakeholders (shareholders, customers, and other partners), increase their visibility, and provide clarity without requiring shareholders (owners) to be directly involved in the company's day-to-day operations. Corporate governance practices aim to ensure the responsibility for achieving intended results (AbuSen and Saad, 2023). Corporate governance practices are considered essential for the success of today's companies, whether they are listed on a stock exchange or not. Are they a large or small corporation? Is there a separation of management and the board of directors? (AbuSen and Saad, 2023). The basic concept of the governance pillars is broadly defined as a network of relationships encompassing not only a company and its owners but also all stakeholders, including employees, customers, people, society, etc. (Hashemi and Bakrani, 2010). The existing definitions of corporate governance fall into the bounded views on one side and the broader views on the other. In the bounded views, corporate governance is limited to the relationship between the company and shareholders. On the other hand, corporate governance can be considered as a network of relations not only between a company and its shareholders but also between the company and most of its stakeholders, such as staff, customers, sellers, company bondholders and all stakeholders within the company (Hasas Yeganeh, 2005). Also, according to Mazraeli et al. (2016), the corporate governance system in Iran is more like an intra-organizational (relational) system.

In addition, there is growing evidence that the board of directors also play an active role in determining the company's direction. According to Hambrick and Mason's (1984) Upper Echelons Theory, the organization reflects its top managers and corporate outcomes due to collective choices by top management teams (Abatecola and Cristofaro, 2018). One of the challenging accounting issues is the joint members (or joint owners) in the structure of a company's board of directors (Richardson, 1987). The joint members of the board of directors mean those who have simultaneously held the position of a member of the board of directors of another company (Mizruchi, 1996). While the board members undoubtedly play a critical role in the company (Fama and Jensen, 1983), the board members' performance has a positive and negative impact on the company.

There is no unanimous definition of complex systems. One informal definition suggests that It is a large network of relatively simple components with no central control, exhibiting emergent complex behaviour (Mitchell, 2006). Some examples of complex systems are the brain, ant colonies, economic markets, and human social networks (Mitchell, 2006). Also, the stock markets are considered multi-actor complex networks according to the interaction between various companies and investors (Huang et al., 2009). Observing the features of complex networks in real networks has led to taking advantage of complex networks' analyses in analyzing real networks. However, in most accounting research, the features of companies and the relations between information and features of companies have been studied (Namazi and Nazemi, 2005), while the companies' relationship to each other, regardless of their characteristics, can have a deterministic effect on the financial state and the trends of the stock market which has been less taken into account. In the companies' board of directors, some owners might be able to determine the board of directors members in other companies. The existence of these owners establishes a relationship among different companies, which can create a complex network of relationships across companies. Therefore, according to the importance of relationship patterns in the decision-making of investors

and creditors, the present study analyzes the structure of the relations network of companies in Iran's capital market where these relations are made by joint shareholders or owners who have the capability of determining the board members in different companies. Indeed, this research attempts to answer two key questions: a) which pattern is followed by the companies' relations structure created by their joint owners? b) Which companies are the key actors in this structure?

Accordingly, the theoretical basis, literature and questions, methodology, research findings, conclusions, and future study suggestions are presented.

2. Literature review

Companies in most countries have a board of directors; in particular, the board of directors is responsible for protecting the interests of shareholders and is principally created for hiring, dismissal, supervision, and rewards for management, all of which are aimed at maximizing shareholder value. The board of directors might include intra-organisational individuals; in some cases, they or their supporters form the majority of the board of directors. Furthermore, it is not unusual for the CEO to be the chairman of the board of directors. Lastly, selecting the board members is one in which most managers have more potential to determine the subsequent members. The significant issues of the board of directors studied in the USA include board members' integration and executive directors' reward. The features of integrating the board members include its size and structure, the number of directors that formed the board of directors, the ratio of non-executive members of the board of directors and the combination of the role of CEO and the chairman of the board of directors.

Competing theories defining corporate governance include agency, stewardship, managerial hegemony, resource dependency, stakeholder, and multi-governance theories (Marie L'Huillier, 2014). In this regard, the dominant view of the relationship between the board of directors and management is based on the assumptions of the agency theory (Arabi and Hassanpour, 2015). Accordingly, it is believed that to protect the shareholders' rights, the board of directors should be smaller and include a higher percentage of non-executive members. Moreover, the roles of the chairman and CEO are separated, and one of the non-executive members is the chairman of the board of directors (Lasfer, 2006). In other words, the non-executive directors must control the company's board. However, one of the controversial issues in the board of directors' structure is the presence of joint members. The joint members of the board of directors mean the percentage of the members of a company's board of directors who are also in the position of a member of another company's board of directors. The joint board of directors may have positive and negative consequences for the company (Mazraeli et al. 2016).

On the other hand, the behavior of the stock markets reflects the results of the mutual interactions among the participators in the market, which tries to maximize its own benefits. Such mutual interactions lead to an increase in the complexity of the behavior of financial markets. The network effect in stock markets provides a better understanding of how individuals have access to information about events and how the reaction of individuals to events affects the stock market. Network analysis reveals the internal structure of stock markets and their evolution over time (Babu Roy and KumarSerkar, 2011). Also, the relationships between ownership and control among companies and the change in ownership affect the power of companies and trends in the stock market and eventually, these relationships reveal their corporate governance network (Moebert and Tydecks, 2007).

The social network analysis focuses on the objective pattern of relationships that bind the individual and collective members of the community (Ritzer, 2004). People rely on their personal

relations and their relatives to access information, resources and positions. These relations form the individual's social network, creating the social system (Sharepour, 2005). In social network theory, actors can be different groups such as individuals, unions, communities, and organizations. The social network, or the source of creating social capital, is a combination of actors and relations (Sharepour, 2007). The social network analysis seeks to encourage researchers from studying social groups to investigate the relations among the actors (Ritzer, 2004). The graphical perception of network theory is related to combining a wide range of sciences such as mathematics, computer science, psychology, geography, communication science and sociology.

A network is defined as a set of nodes connected by lines. Nodes are usually actors. The ties or edges connect actors, each of which can affect network dynamics (Garton et al. 1999). On the other hand, the stock markets are considered a type of complex network due to the interaction between various companies and investors. A financial market is a network in which the nodes represent financial institutions (e.g. stocks) and the edges represent the relation between their returns (Boginski et al., 2005; Mantegna, 1999). Considering the features of complex networks in real networks makes it possible to take advantage of the analyses of complex networks to analyze real networks.

Sankowska and Siudak (2016) studied the networks of boards of directors and corporate executives of big companies in the Polish capital market in 2014. They have also investigated the real networks of the board of directors and corporate executives compared to the randomly constructed networks. The experimental results have represented that real networks have the characteristics of small world networks. Furthermore, the networks are organized and classified and certain behaviors are applied.

Singh and Delios (2017) studied the relationship between the structure of the board of directors and the risky behaviour of emerging companies. Their focus was on examining the individual and joint effects of the board structure, the centrality of the network by communication and the ownership structure in the company's development strategies. The research results have shown that companies with non-executive members of the board of directors and CEO duality and companies central to the other corporate networks are more likely to develop through new domestic or foreign investments.

Dastkhan and Gharneh (2018) have studied how the ownership structure becomes inclusive in financial markets. They have also introduced an ownership network-based simulation model for analyzing systematic risk events. Research results have shown that the network structure influences the probability and extension of financial systems. For each network structure, different parameters have different values, leading to a significant difference in the systemic risk measurements. Furthermore, the obtained results represent that the proposed model is suitable for systematic risk analysis and permeation in financial markets, identification of important systematic companies, and estimation of the loss of the market when the primary failures occur.

Withers et al. (2018) have studied the evolution of the board of directors' network after Sarbanes-Oxley. They examined the impact of the Sarbanes-Oxley law on the evolution of the interaction of the board of directors of 300 Fortune companies from 1998 to 2006. According to the specific emphasis on the directors' responsibilities and the board's independence, Sarbanes-Oxley has created a significant difference in the demand and supply of the labor market for corporate executives. Therefore, they examined whether the supervision changes have led companies to pay more attention to social processes involved in choosing a board member such as reciprocity, transparency and multiplicity after Sarbanes-Oxley. The results of their research have shown that following the Sarbanes-Oxley law, the tendency of companies to abuse the interactions of the board of directors has been reinforced. Similarly, companies have trusted more to their existing partners to

fill their board chains after Sarbanes-Oxley.

Taghizadeh et al.(2019a) analyze the Tehran Stock Exchange shareholder network from 2013 to 2017. The research results posited that many shareholders are connected, although a class structure governs their relations. In comparison with others, some shareholders have a better position, which in turn causes them to encounter fewer mediators in gaining access to other shareholders and, therefore, easier access to available resources.

Fan et al. (2021) investigated the impact of social networks between independent directors and the CEO on firm risk. They found that social networks between the board and CEO positively impact firm risk. In particular, CEOs who are socially connected to their independent directors are motivated to pursue riskier investment, operating and financing strategies. This positive influence is more pronounced for prior under-performing firms and CEOs with low power or overconfidence.

Taghizadeh et al. (2021) analyze the interpersonal relationships network in the Tehran Stock Exchange (TSE) from 2013 to 2017. The research results posit that some individuals, compared to others, have a better position in communicative networks. Therefore, it might be concluded that these individuals are key actors in the governing structure of the TSE. Furthermore, this network follows a kind of bus morphology, i.e. individuals act as a bridge for other units and connect them to the core of the communication network.

Luong et al. (2023) investigated the relationship between CEO-director ties and female representation on the board in U.S. firms. They find a significant and negative effect on this relationship, suggesting that socially connected directors are detrimental to gender parity in senior management.

Fan et al. (2023) examined the impact of CEO network centrality on bank risk. They find that CEO network centrality is negatively related to bank risk because CEOs with higher network centrality implement less risky policies. In addition, they document that information flow and CEO power are two channels through which CEO network centrality reduces bank risk.

2.1. Research questions

As mentioned above, this research aims to analyze the communication network between shareholders and managerial owners (this communication created by common shareholders and owners that can determine the board of directors members) involved in Iran's capital market.

To achieve the research goal, the following questions have been addressed:

Which pattern does the companies' relation structure in the stock market follow?

Which companies are the key actors in this structure?

3. Research methodology

This research is practical. Its methodology is quasi-experimental, using a retrospective approach (through past information). Also, according to the collected and analyzed data type, the research is quantitative research with network analysis types. The main approach of this study is to use graphical techniques based on graph theory (a branch of topology). Applying matrix algebra allows the notion of relationships among actors (nodes) in a network to be studied visually, algebraically or logically. The concepts used in this theory include node (point), line or edge, line direction, line sign, path, path distance, bridge break point, connector etc. The details of the research method are put forward as follows:

3.1. Network analysis method

Network theory is a mathematical framework for modeling interacting systems as networks (or

graphs) formed by a set of relations (edges) between discrete entities (nodes). Additionally, nodes can carry time varying dynamical processes or signals, including the activity of neurons or a behavioral feature (e.g., velocity) of individual animals. Because of their generality, ability to encompass different datasets, and favoring of interactions rather than spatial layouts (in physical or state space), network models are uniquely suited to bridge across the neuroscience of individual and collective animal behaviors. They can also discover universal structure-function relationships robust to uncharacterized interaction parameters.

In addition to the overall analysis of the shareholding network, the performance of each node in the network is also studied using the micro indicators. Centrality, as one of the most important concepts of network analysis, studies the importance and influence of individuals on the network. The network node centrality can be studied using three indicators: degree, betweenness and proximity. The centrality degree of a node in a social network represents the number of links a node has with other nodes. In other words, in a shareholding network, the centrality degree of each individual represents the number of his/her relations with other members involved in the network through joint corporates (the corporates in which shareholders have determined the members of the boards of directors). The centrality degree of node k (p_k) is calculated by eq. (1):

$$C_D(p_K) = \sum_{i=1}^{n} a(p_i, p_k) \quad (1)$$

Where n is the number of nodes in the network, $a(p_i, p_k)$=1 if two nodes p_i and p_k are connected and otherwise, it is zero.

The betweenness indicator of a node indicates the number of times that node is located in the shortest path between two other nodes in the network. Nodes with high betweenness play a key role in information stream and network connectivity and have a central position in the network. The betweenness indicator of node k (p_K) is obtained by eq. (2):

$$C_B(p_K) = \sum_{i<1}^{n} \frac{g_{ij}(p_k)}{g_{ij}} ; i \neq j \neq k \quad (2)$$

Where g_{ij} is the shortest path between p_i and p_j link; and $g_{ij}(p_k)$ is the shortest path between p_i and p_j link passing through p_k.

The proximity indicator of a node represents the average length of the shortest paths between that node and other nodes in the network. Nodes with high proximity indicators have a greater influence on the network, play a key role, and have higher availability for other nodes. The proximity indicator of node k (p_k) is obtained by eq. (3):

$$C_C(p_K) = \sum_{i=1}^{n} a(p_i, p_k)^{-1} \quad (3)$$

where $d(p_i, p_k)$ is the shortest path between two nodes p_i and p_k (Abbasi et al. 2012).

Eigenvector in network analysis is known as a measure of network centrality and is calculated as follows (Bienenstock and Bonacich, 2021):

$$\sum_j a_{ij} x_j = \lambda xi \quad (4)$$

Or in compact form:

$$Ax = \lambda x \quad (5)$$

λ is the principle eigenvalue for an adjacency matrix A, and x is the eigenvector associated with the eigenvalue. This eigenvector is interpretable as a measure of centrality. Intuitively, a position is central, with respect to eigenvector centrality, if it is connected to other positions with several connections.

3.2. Conceptual and operational definition of research variables

In this research, according to Sankowska and Siudak (2016), Singh and Delios (2017) and Withers et al. (2018), the names of shareholders who are the members of the board of directors (or, in other words, they determine the members of the board) have been used to obtain the board of directors and network of the involved companies in Iran's capital market. Therefore, the relationship among companies is studied based on those shareholders who have the power to determine the board members. If a shareholder determines the members of the board of directors in two companies, it makes interaction between two companies through either the same shareholder or joint ownership. The interactions among companies are studied at two levels: a) board of directors and b) board of directors. This means that once the interactions among companies are studied via shareholders, who have the power to determine the board members in multiple companies, the interactions among companies are studied through stakeholders who have the power to determine the board members. To analyze the network of the board of directors as well as the board of directors, the general network, the isolated units, proximity based network, proximity, betweenness based network, betweenness, degree based network, degree (degree, proximity and betweenness are the criteria related to the centrality indicator. This indicator refers to the location of particular nodes within the network) are discussed and analyzed.

3.3. Data, research period, and sample

All the companies listed on Iran's capital market were selected as the study's statistical population. In this regard, all active companies from 2019 to 2022 and their information were available to be studied. It must be mentioned that no sampling is performed. Therefore, according to the terms and conditions, 618, 744, 794, and 806 companies have been selected to be reviewed from 2019 to 2022, respectively. The necessary data and information have mainly been collected through the Tehran Stock Exchange websites and Rahavard Software databases. In addition, the results were analyzed using the network analysis method, as well as Excel 2016, PreMap v1, and UCINET v6, as well as its complementary package, NetDraw.

4. Findings

4.1. Descriptive statistics

As mentioned above, the research analyzed the companies' network of relations among the board of directors. Table (1) lists the descriptive statistics of the studied quantitative data for research patterns. These statistics are related to the interactions made among companies through their joint board of directors.

Table 1. Descriptive statistics of the research period

	2019	2020	2021	2022
Mean	4.580	4.860	4.960	4.970
Median	5.000	5.000	5.000	5.000
Standard deviation	1.2000	0.810	0.680	0.660
Minimum	2.000	2.000	2.000	2.000
Maximum	11.000	8.000	8.000	8.000
Total	2834	3622	3944	4010
Number of observation	618	744	794	806

The number of observations illustrates how many companies were selected and investigated annually. The total shows the number of boards of directors each year that connection was created through them. As it shows, the maximum number of companies and board members is 2022. The

average shows that each year, and each company how many boards of directors existed that connection on average. The maximum (minimum) shows the most (least) number of boards. In general, descriptive statistics illustrate that from 2019 to 2022, the frequency of board members, a common factor for a relationship, is increasing.

4.2. Overall networks

Figures (1), (2), (3), and (4) represent the overall network of corporates' interactions through their joint board of directors. The corporate network usually consists of three parts: the main, marginal and isolated. The number of marginal and isolated units is less than the main one, which means that most companies are connected and the number of companies without any relation is few. There are companies with different degrees of relations in the main part.

The main part of the network is divided into three levels: core, semi-periphery and periphery, where the relations are dense, semi-dense and scattered. The main part has a closed structure and a gap between the successive levels; there is also a class-based structure. The core level has a dense structure. It has high relations and centralized and monopoly power; the semi-periphery level is more open and semi-dense. The monopoly is lower in this part. The peripheral level has a scattered and open structure. The structure of the peripheral part is more open and robust than the semi-peripheral level and the semi-periphery is more open and robust than the core level.

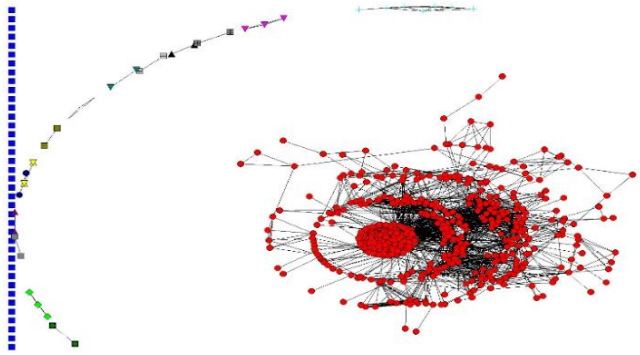

Figure 1. Overall Network 2019

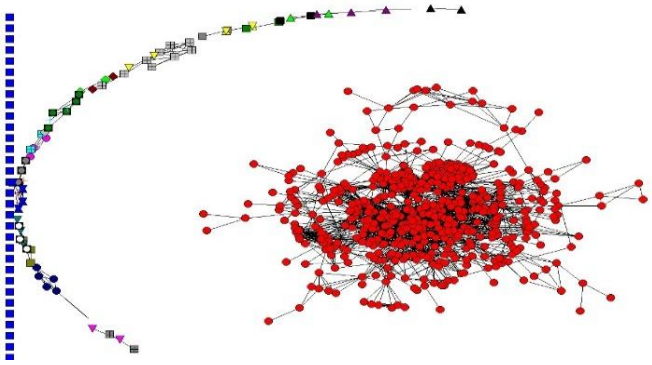

Figure 2. Overall Network 2020

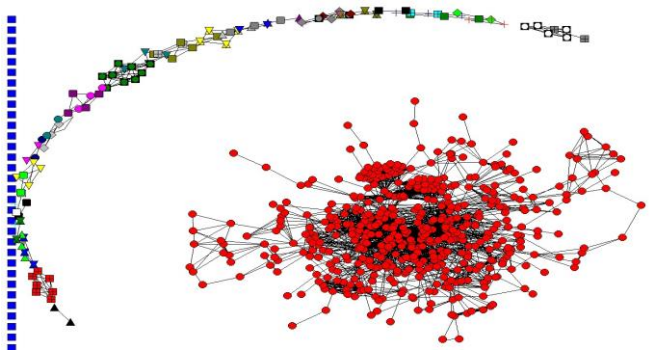

Figure 3. Overall Network 2021

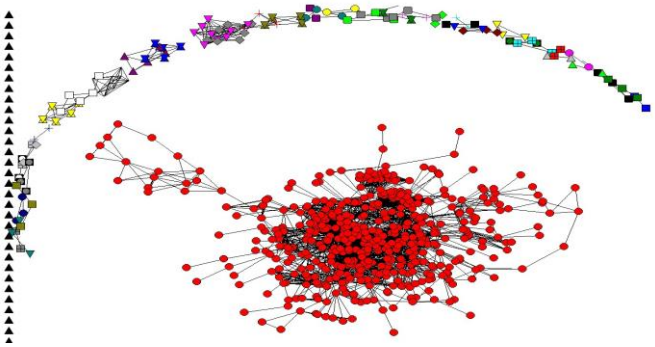

Figure 4. Overall Network 2022

4.3. Isolated Unit

Table (2) lists the number of isolated units per year. Isolated units do not relate to others (the blue units at the margin of Figures 1, 2, 3, and 4 are isolated units). For example, in 2022, 175 companies at the board of directors level do not have any relation with other companies through any other board member. As can be seen, the maximum number of isolated units belongs to 2022.

Table 2. Number of Isolated units

	2019	2020	2021	2022
Board of directors	55	132	159	175

4.4. Cliques

The larger the number of groups, the more units are gathered together; so the relations have been transformed from dual state into multiple states, and to some extent, the dispersion is lower and coherence is higher. The maximum number of groups belongs to 2021. Table (3) lists the number of groups per year.

Table 3. Number of Cliques

	2019	2020	2021	2022
Board of directors	258	248	266	256

4.5. Degree

The degree of centrality is simply the number of direct relationships that a node or entity (here the company) has; a node or entity has a high degree of centrality; in general, it is the active actor in the network, often it is a relation or axis in the network, but it is not necessarily the most relevant

entity or node within the network, it may be in a privileged position on the network, it may have alternate ways to satisfy or meet the organizational requirements, and therefore it may be less dependent on other individuals and can often be considered as a handler. The higher the degree of centrality of an individual, the more effective relations and connections there are. Figure (5) shows a network based on degree centrality (degree).

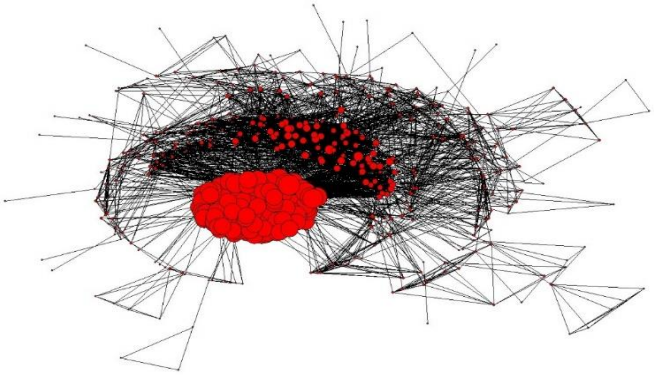

Figure 5. Network Related to Degree 2019

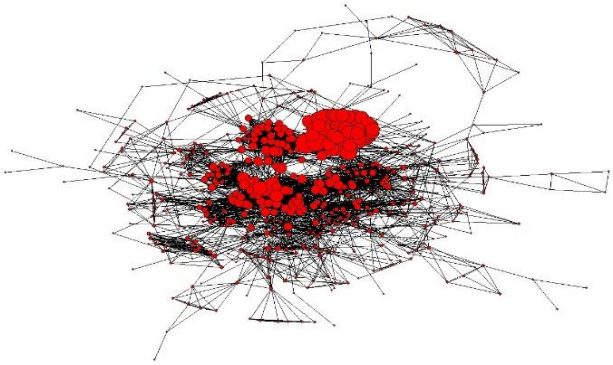

Figure 6. Network Related to Degree 2020

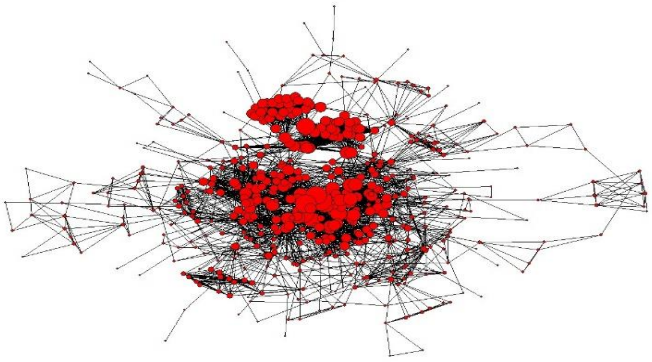

Figure 7. Network Related to Degree 2021

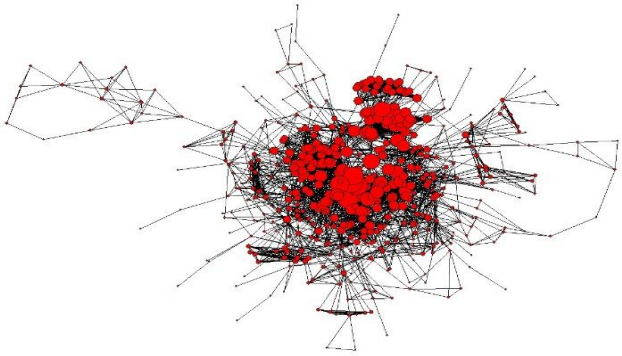

Figure 8. Network Related to Degree 2022

As can be seen in Figures (5), (6), (7), and (8), in terms of the degree, there are three levels of core, semi-peripheral and peripheral, which are dense, semi-dense and scattered, respectively. The difference across levels is significant, but the difference in units at each level is lower, leading to a class-based structure. There are high-level companies with relationship degrees, with a significant difference between them and the next level. This can lead to the formation of relational colonies and the creation of a monopoly rent space among the high level units. It should be noted that a high level of relationship does not necessarily mean that they can affect each other's common actions.

4.6. Closeness

The centrality of proximity implies that a node or entity (here, company) can quickly access more nodes or entities in the network. The shorter the path a node has to access to all the nodes, the closest node to all the other nodes, the higher the centrality of closeness is. This indicator reflects the ability to obtain information through the cluster of network members. In general, an entity with a higher centrality of closeness has quick access to the other entities on the network, a shorter path to the other entities, and high visibility on what is going on in the network. Figures (9), (10), (11), and (12) represent the network based on the centrality of closeness (closeness).

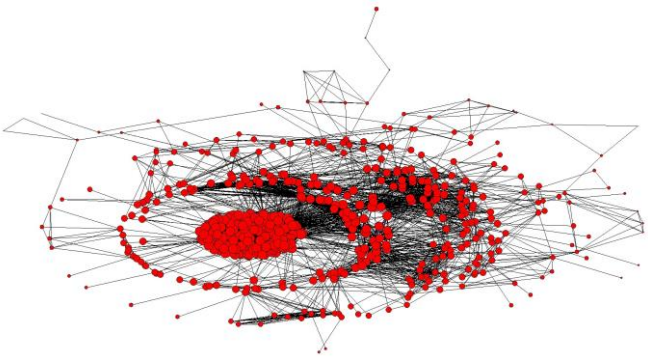

Figure 9. Network Related to Closeness 2019

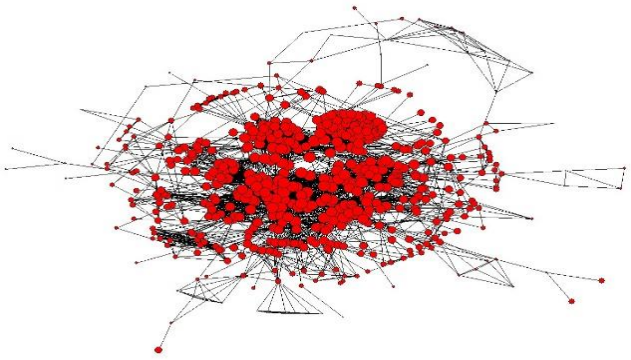

Figure 10. Network Related to Closeness 2020

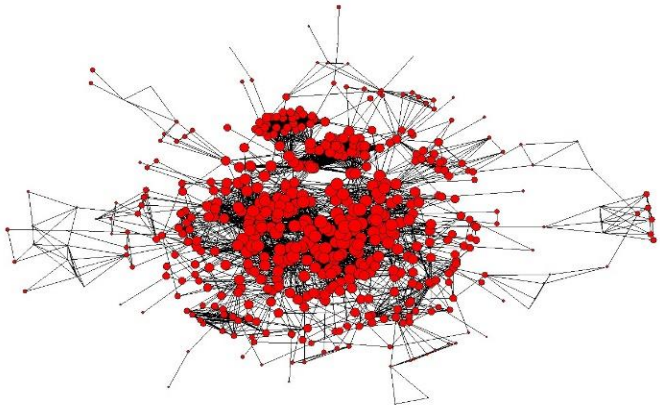

Figure 11. Network Related to Closeness 2021

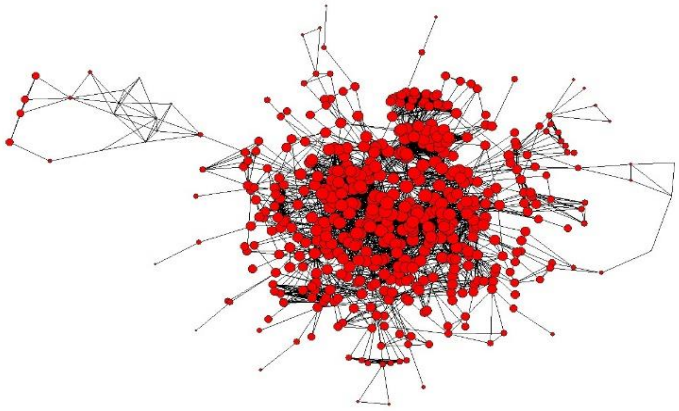

Figure 12. Network Related to Closeness 2022

Figures (9), (10), (11), and (12) show three levels of core, semi-periphery and periphery, which can be seen in closeness. The difference across levels is significant, but the difference in units at each level is lower, leading to a class-based structure. Some companies interact with fewer mediators and have relatively fast accessibility. On the other hand, some companies have difficulty accessing them with more mediators. This can lead to monopoly rent across high level units and impose high costs on the peripheral units.

4.7. Betweenness

The centrality of betweenness refers to the position of a node or entity (here company) within the

network regarding its ability to link other pairs, colonies or groups. Also, it shows how far the node is in the relational path of the other nodes and the communication is made through it (Taghizadeh et al., 2019b). As the network nodes depend on a node to communicate with others, that node will have more power on the network. If a node that is the only connector between two nodes or groups is lost, the exchange of information and knowledge between these two nodes or groups is disrupted. Figures (13), (14), (15), and (16) represent the network based on the centrality of betweenness (betweenness).

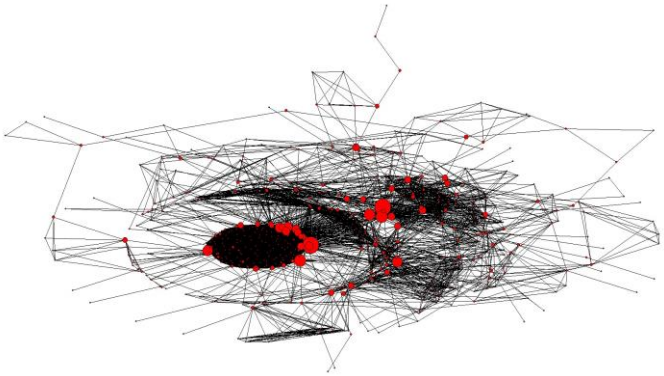

Figure 13. Network Related to Betweenness 2019

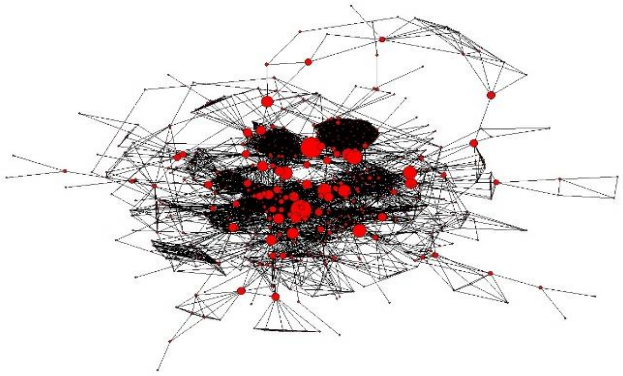

Figure 14. Network Related to Betweenness 2020

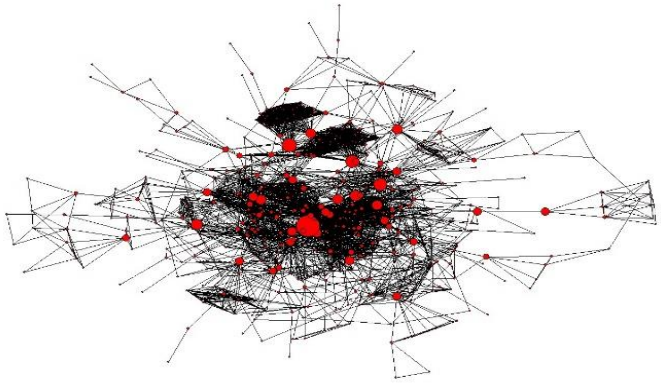

Figure 15. Network Related to Betweenness 2021

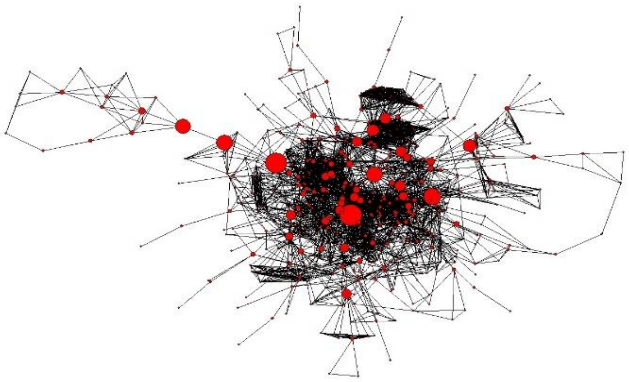

Figure 16. Network Related to Betweenness 2022

As shown in Figures (13), (14), (15), and (16), there are three levels of core, semi-periphery and periphery in terms of betweenness. The difference between the levels is not necessarily high. Still, the difference of units at each level is very high, and there are units with high betweenness power within the network, which are units that do not necessarily belong to the network core. Some units in the network belong to the semi-periphery and periphery levels but have high betweenness power (points represented by large circles). These are units through which other units pass them. These units are able to isolate or enhance the communication. On the other hand, units with high betweenness affect the joint action of other units. Namely, if the given unit does not exist, that common behavior would not occur. In practice, each of these units has common behavior since they act according to the behavior of the given (major) unit. In general, the betweenness feature is observed to be significantly different among companies, and the number of companies with high betweenness is low over the entire network. This shows that there are units in the network with more and easier access to the information stream and higher effective power that can lead to a proper decision and, on the other hand, lead to economic rents. The companies with the highest betweenness and significant difference from others are presented later (shown in red circles).

4.8. Eigenvector

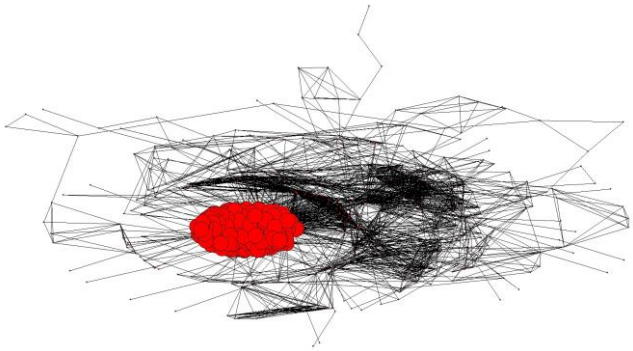

Figure 17. Network Related to Eigenvector 2019

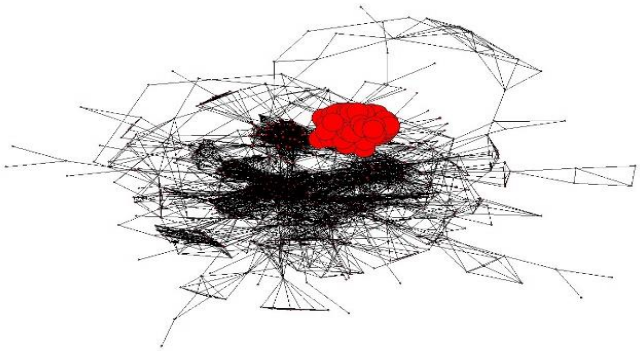

Figure 18. Network Related to Eigenvector 2020

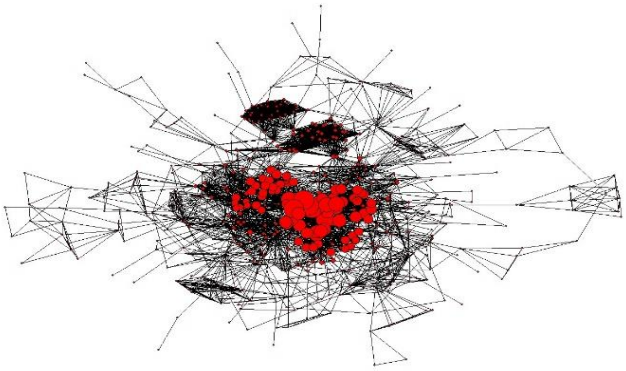

Figure 19. Network Related to Eigenvector 2021

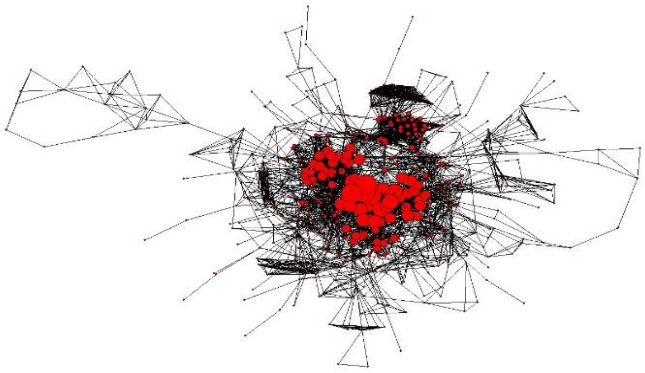

Figure 20. Network Related to Eigenvector 2022

Furthermore, from Figures (17), (18), (19), and (20) (network based on eigenvector-vector centrality), we can see that highly influential units in the network are better positioned than other units. In graph theory, eigenvector centrality is a measure of the influence of a node in a network.

Every node in the network is assigned a relative score based on the assumption that connections to nodes with higher scores contribute more to a given node's score than the same connections to nodes with lower scores. A high eigenvector value means the node is connected to many nodes with high values (large red circles indicate the diagram's companies).

5. Conclusion and discussion

The basic concept of governance principles is broadly defined as a network of given

relationships that includes a company and its owners and all stakeholders, including employees, customers, people, society, etc. Furthermore, the board of directors is one of the major pillars of the corporate governance system that can influence corporate decisions. On the other hand, stock markets are considered a complex network due to the interaction of various companies and investors. Viewing the properties of complex networks in real networks makes it possible to analyze complex networks in these networks. Observing the features of complex networks in real networks has led to taking advantage of the analyses of complex networks in analyzing these networks. Also, studying the relationship among companies can have a determinative effect on the financial situation and stock market trends. Therefore, this research aims to study and analyze the company's relationship network structure. These relations are created by the joint shareholders or owners who have the power to determine the board of directors members in different companies. In this regard, the network analysis method and the concept of board members of the involved companies in the stock market in 2019-2022 are used. This research tries to answer two key questions: a) what is the pattern of the relations among companies created by their joint owners? b) Who are the key actors in this structure?

Research findings show that the companies' network usually consists of three parts: main, margin, and isolates. The number of isolated units is low in this network; those units have no interaction with other units. The network's main part consists of an interconnected structure where the extent of interaction is high and the power is centralized and individualized. There is a gap among levels, and the structure is class-based. Also, there are three main levels: core, semi-periphery, and periphery, where the relations are dense, semi-dense, and scattered. The difference among levels is so high, but the difference in units is low. The indicators related to position, importance, and impact (centrality indicators: degree, proximity, and betweenness) of the network represent that the central companies have the highest network relation and significant differences from other units. These extensive relations can lead to appropriate communication and business space for the central units. On the other hand, it may result in a monopoly rent space for those units. Furthermore, the central companies communicate with each other with fewer mediators and have relatively fast access. However, for peripheral companies, more mediators provide access. In fact, high level companies have more ability than the peripheral networks to acquire information through the cluster of network members which can lead to a monopoly rent space for high level units and will impose a high cost for the peripheral units.

Communication among companies happens via some units. Through their communication, these units make other units behave in certain ways. Therefore, they are key players. In fact, how different companies communicate generally depends on their path, which indicates the higher influence of these units over others. In addition, they have easier and more access to the information. It must be noted that these units do not necessarily belong to the network's core, which means that there are units in the network that are at the semi-peripheral and peripheral levels but with high influencing power. Indeed, in the companies' relation network, the betweenness feature is more tangible and visible than degree, followed by degree and proximity.

The methodology used in this research can also be used to identify and analyze key players in other realms of finance and accounting. In total, according to the findings, it can be said that understanding the macrostructure of connections among companies is vital. Therefore, according to the obtained results and the importance of connection structure and influence of key players in decision making, it is advised to all users to consider the governing rules related to existing companies in capital markets and their roles and positions in reaching their goals.

In addition to the benefits obtained from the network analysis method, the above method also has some constraints, so improving and eliminating these constraints can be the starting point for future

research. The present research has only been limited to using widely used criteria of network analysis, while other criteria relating to network analysis can be used. Furthermore, other methods related to the network or a combination of these methods, such as graph theory, can be employed. In future works, the investment strategies in stocks and other networks between companies can be studied.

In fact, the results of this paper can lead to a better understanding of players who create the relation structure among companies and boost the usefulness of the decision-making of politicians and main players. Furthermore, considering that there are companies with special situations in regard to the other companies, it is advised that the authority of market capital continuously monitors the companies with unique positions in the network. In other words, it is recommended that investors and other users use social network analysis in decision-making about selling and buying stocks, decreasing portfolio risks, and making other decisions.

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Wavelet Analysis of Stock Returns and Total Index with Moving Average of Stock Returns and Total Index

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Abstract

This research aims to investigate and analyze the behavior patterns of stock market fluctuations so that appropriate strategies with varying time horizons can be determined based on the characteristics extracted from different time layers and the level of economic activity Measured by the investors. This research investigates and analyses stock market fluctuations in different periods by applying discrete wavelet transformation with maximum overlap in MATLAB software. For this purpose, the variances of effective indicators are compared and analyzed during 2011-2023. This research shows that the wavelet variance of the stock return is more than the moving average of the stock return. According to the movement scales of each stock return and the moving average of the stock returns during the long-term scales, the wavelet variance is less and the comovement is less. Still, during the short-term time scales, the comovement is greater, and the variance of the wavelet return is greater among them. The variance of the moving average of the total index is greater than that of the total index. According to the movement scales, each of the total index and the moving average of the total index has less wavelet variance and less comovement during the long-term scales. Still, the commitment has increased during the short-term time scales, and the wavelet return variance is higher.

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1 Introduction

Studying the behavior of returns and volatility in the return of securities and analyzing them necessitates the discovery of a behavioral pattern of stock returns. If this pattern is discovered, shareholders can select the best stocks by evaluating their and other stocks in the market. As a result, they can hold, sell, or replace stocks.

Consequently, the temporal stability and linearity of the relationships between variables can be supposed when over changes within the company such as change of management, change of production lines, change in the composition of a company's inputs (manpower, capital, and the like), changes in economic conditions, changes in tastes, changes in government policies, increasing competition in the relevant industry, etc. should not occur in the business unit. While such changes occur continuously throughout the life of a company, it is usually to be expected. Determining the trend of time changes in the rate of return and variance of returns can be helpful in accurately estimating them and thus promoting more accurate decisions for investors. These issues lead us to use more relevant and adaptable methods to accurately calculate financial variables. For this reason, one of the most accurate ways to predict variables is to calculate them in the context of different time scales and compare the results of each scale with another scale. Consequently, in this study, the objective is to calculate the variables in the framework of different time scales by using a new and innovative tool called wavelet analysis and more clearly describe the relationships between variables, determine the optimal period of holding stocks in the Tehran Stock Exchange and also changes in variables to use them in economic decisions by investors in the stock market. In various fields of financial analysis and investment management, the calculation of the rate of return and variance of return is based on a time scale. In contrast, this calculation method leads to errors in professional and scientific decisions and analysis. In previous studies, due to the limited time scale in recognizing the real and dynamic relationship between returns and stock market volatility in different industries, the main issue in this study is to determine the real and dynamic relationship between returns and market volatility of different industries in different time horizons so that the key results can be used to measure the predictive power of returns and stock market volatility in determining the level of economic activity of investors. Accurate measurement of these relationships helps investors predict stock market movements in the future.

2 Literature review

The main objective of creating capital markets is to collect micro and macro capital and invest them in various industries to increase production and economic growth. On the other hand, the level of economic activity of investors (with the purpose of business or investment) is particularly important in the country's economic growth. Investors and capital market participants need to analyze reliable and relevant information to predict other investors' performance and the market's future trends.

Based on the discounted cash flow valuation model, companies' stock prices reflect investors' expectations of companies' future profitability. So, in general, if investor expectations are moderate, stock prices should provide information about future economic conditions as the company's interests are fully related to the level of economic activity.

Several applications of wavelet analysis in economics and finance have been proposed by Ramsey (2002), Kim and In (2003), etc.. Still, no research has been done on applying this tool to wavelet analysis of the relationship between stock market returns and the level of economic activity.

Developing countries, including Iran, have high volatility in stock prices, creating an uncertain environment for investors. Over the past decade, the stock market has played a greater role in the

Iranian economy and has experienced much volatility, as well as explaining the comovement of macroeconomic variables such as production, consumption, and investment in Iran with volatility in stock prices due to the predictive nature of prices, determine the stock market as one of the predictors of trading cycles. In addition, if the information reflected in stock prices is of high quality, these prices can also provide an accurate forecast (Shahrabadi and Bashiri, 2021).

Economics and financial phenomena may exhibit different characteristics at different time scales, so wavelet analysis tools can examine the multiple characteristics of these phenomena. Wavelet analysis is suitable for identifying periodic and seasonal patterns, structural failures, and trends, as well as multivariate analysis. This tool is used to study the behavior of unstable financial time series in the framework of different time horizons, simultaneously analyze the time and scale of financial data, and make it possible to calculate pairwise correlations in different time horizons. Wavelet analysis is a powerful tool for quantifying time series data at different time horizons quantitatively, and without losing any decision-making information, a time series is analyzed at the highest possible frequency using different time scales. This tool differentiates between seasonality, detects structural interruptions and volatile groups, identifies a process's internal and external dynamic properties at different time scales, and studies unstable events in series. Wavelet filtering provides a natural way to deal with the different time characteristics found in series, rejecting the static assumption. However, this research will use wavelet analysis methods to analyze the time series of returns and market stock volatility based on scale.

Different time horizons change the structures between variables and, consequently, the decision structure from fixed to dynamic. High stock market returns increase confidence in price trends and the transfer of economic activities from unproductive to productive (production), thus increasing physical and human investment. So, the main purpose of this study is to analyze the effects of returns and stock market volatility on the economic activity of investors in Iran via different time scales using wavelet analysis, which is done for the first time in Iran. This new approach is based on the wavelet multi-scale method in which a time series is decomposed into different scales. The most important advantage of wavelet analysis is its ability to decompose data to multiple time scales. Many investors in the securities market do securities trading and make decisions on different time horizons; now, traders can be embodied as minute to minute, hour to hour, day to day, month to month, or year to year. In fact, due to the different time scales that different traders have for decision making, dynamic and realistic structure, effective nature of returns, and stock market volatility on economic activity, the relationship between different time scales can be changed. Economists and financial analysts have long considered the idea of analysis in decision-making for several periods. However, due to the lack of analysis tools, this fact has been limited to analyzing data over short- and long-term time scales. This study will provide an orthogonal wavelet analysis of covariance, correlation, and cross-correlation between stock market returns and economic activity at different time scales. Furthermore, variance and covariance of the different time scales will be analyzed to understand the true relationship between stock market returns and economic activity.

Osu et al. (2020) examined the common movements of the Nigerian stock market with the 11 N markets (Bangladesh, Egypt, Indonesia, Iran, Mexico, and Nigeria). They also examined the effect of volatility on market dynamics and used some wavelet-based measures to analyze market dynamics. The results showed a powerful joint movement among N11 countries, and noise had almost the same effect in terms of time-frequency for all N11 countries. It can be supposed that most of the market dynamics of N11 countries at lower scales (high frequency) are due to sharp volatility, while market principles drive higher scale dynamics (low frequency). Deviation and kurtosis can also determine the energy distribution in wavelet decomposition. Zhou et al. (2018)

studied the international stock market contagion: A CEEMDAN wavelet analysis. In this study, they used the CEEMDAN wavelet model (complete experimental mode analysis of the group with consistent noise) and examined the effect of contagion in stock markets (Asia, Europe, and the US) under different time frequencies. The results revealed that shocks caused by irregular events and severe accidents can be transmitted between different stock markets. Furthermore, shocks from irregular events can pose a sudden, short-term risk to stock returns. And shocks from severe accidents can pose a positive and lasting risk to stock returns. Lin et al. (2018) used wavelet analysis to examine the relationship between stock returns and bonds and stock market uncertainty. The results showed that the short- and long-term relationship between stocks and bonds showed many differences in different periods. It was also found that the relationship between bonds and stocks has a negative sensitivity to stock market volatility. It was also found that financial crises significantly negatively impact the relationship between bonds and stocks in the long run. Tiwari et al. (2017) used wavelet analysis to examine the relationship between inflation and stock returns over a long period (1790 to 2017) and at different frequencies. The results are compared with those in the United States and two developing countries (India and South Africa). Generally, the results of this study indicated that while the relationship between inflation and stock returns varies extensively at different frequencies and time intervals, there is no evidence that stock returns are a cover for inflation. Such a conclusion was true in both developed countries, the United Kingdom and the United States, and the two developing countries of India and South Africa. Boubaker and Raza (2017) conducted a study entitled "A wavelet analysis of mean and volatility spillovers between oil and BRICS stock markets". The results of this study reveal that oil prices and stock market prices are directly affected by the news and volatility of their market and are indirectly affected by volatility in prices other than wavelets. Likewise, volatility spillover effects and averages are affected by many overflows except in different time dimensions based on heterogeneous investors and market participants. Yilmaz and Unal (2016) used wavelet analysis to examine the volatility of Asian stock markets based on the FTSE100 and S&P 500 financial indicators. The results of wavelet analysis indicated that there are internal relationships between these stock markets, which have changed at different time intervals and frequencies. At the same time, it was observed that the stock markets of countries with advanced economies have greatly impacted the stock markets of Asian countries. However, the degree of dependence of Asian stock markets on strong global markets varies from country to country, and these differences can be seen in different periods. Çelik and Baydan (2015) show that stock exchanges with a high concentration of foreign investors have been highly affected by recent global financial crises. Furthermore, the discussion of asymmetric transmission using significant and different wavelet corollary results has been almost confirmed for some emerging economies. Masih and Majid (2013) conducted a study entitled Selectivity of Selected International Stock Market Indicators: A Continuous Wavelet Analysis and Cross-sectional Wavelet Analysis. The results of this study can be an important tool in decision-making for different types of investors. Kazemzadeh et al. (2020), using a discrete wavelet converter with maximum overlap and threshold autoregressive pattern of interaction of inflation and government budget deficit, studied from new angles two cases of total deficit and operational Deficit in the economy of Iran in 1990:1-2017:3. The results based on the wavelet converter show that in the horizons of more than 8 years, there is a causal relationship between both types of the budget deficit and bilateral inflation. Based on the results of estimating the threshold autoregressive pattern, in seasonal inflation less than 6.28%, the total budget deficit increases sharply in the face of the inflation shock. Likewise, the operating budget deficit before and after the threshold positively responds to the inflation impulse. Explaining that at seasonal inflation rates above 2.54%, the reaction intensity of this variable will be higher. In other words, the Tanzi effect is always stronger

than the non-Tanzi effect. Fallahi et al. (2019) decompose a new approach using the wavelet analysis method that inspects the returns of a particular investment strategy into multiple investment horizons. The results of their research show that in investment companies with medium and low-risk aversion, with increasing investment horizon, the amount of investment in low growth stocks and the amount of investment in value stocks has increased. In contrast, the weight of growth and value stocks were not significantly different in the stock market portfolio survey. Seifollahi (2017) conducted a study entitled "Negative Relationship between Credit Risk and Currency Risk with the Price Return of Bank Stocks in Iran (GARCH-M approach)". Regarding the research findings in the Iranian banking system, there is a negative relationship between credit risk and foreign exchange risk with the stock price returns of banks listed on the Tehran Stock Exchange. This indicates the innovation of this research. There is also a positive relationship between credit risk and foreign exchange risk and the risk of price returns on shares of banks listed on the stock exchange and securities. Rostami et al. (2016) show a significant relationship between the returns of various industries in the Tehran Stock Exchange and the returns of oil, gold, dollar, and euro markets. A stronger relationship exists between independent and dependent variables at shorter intervals. Besides, based on the sum of beta coefficients of independent variables in different periods and industries, it is determined that the variables of oil, gold, dollar, and euro prices have the most power to explain the index of different industries, respectively. Abbasi et al. (2016) investigated the relationship between trading volume, stock returns, and volatility in returns at different scales in the Tehran Stock Exchange. The results obtained from this study in the period under study show the difference in relationships between variables at different time scales, as in some scales, the Granger causality test confirms the existence of a causal relationship between time series.

3. Research methodology

This research is applied in terms of purpose, quantitative approach in data nature, and descriptive-correlational in data collection method. The statistical population of this research includes active indices in the Tehran Stock Exchange market; among all indices, the total index and price index have been used as samples. To this end, information about the stock market price index and the total index will be collected daily in the period 2011-2023; then, using wavelet analysis, time series are broken into different time intervals, and then with the correlation analysis method, the relationship and the effects of returns and volatility of stock market returns on the levels of economic activity in different periods will be studied. This research uses MODWT (maximal overlap discrete wavelet transform) to study the relationships between variables in Iran. The correlations between stock price indices and industrial production will be estimated at different time points of wavelet conversion.

The wavelet base comprises a parent wavelet representing the data's main process. Wavelet transform determines the number of frequencies in the signal and when those frequencies occur from the signal. Wavelet transform attains this ability by working at different scales. In wavelet conversion, we first consider the signal with a large scale or window and analyze its large features. In the next step, we look at the signal with small windows and get the small characteristics of the signal. In general, it can be said that wavelet transform acts as a compromise. On scales where time-dependent properties are more attractive, the wavelet transform has a higher resolution in the time domain, and on scales where frequency-dependent properties are more attractive, it has a higher resolution in the frequency domain. This type of compromise is exactly what the goal is in signal processing.

The discrete wavelet transform is implemented as a filter bank, acting as a sequence of low-pass and high-pass filters. We start with small scales corresponding to high frequencies to apply a discrete wavelet transform to a signal. Consequently, we first analyze the high frequencies. In the second step, we increase the scale by a factor of two (we decrease the frequency by a factor of two), in which case we analyze the behavior around half the maximum frequency. In the third step, we consider the scale factor 4 and analyze the frequency behavior around the quarter of the maximum frequency. This process continues in the same way to reach the maximum level of decomposition. Discrete wavelet transform returns two sets of coefficients as output: Approximation and Detail Coefficients. Approximation coefficients represent the output of the low-pass filter (Averaging Filter) in the discrete wavelet transform; the coefficients of detail indicate the output of the low-pass filter (derivative filter) in the discrete wavelet transform by applying the discrete Fourier transform again on the previous wavelet conversion approximation coefficients, we obtain the next wavelet transform, in each step, the sampling of the primary signal with factor two is reduced.

In each successive stage of the discrete wavelet transform, the approximation coefficients are divided into low-pass and high-pass parts. The wavelet transform is applied again on the low-pass part in the next step. As can be seen, our main signal is now converted into several signals, each corresponding to different frequency bands. Approximation and fractional coefficients under different bands are used in applications such as removing high-frequency noise from signals, compressing signals, or classifying different signals.

The idea of signal analysis with different scales is called multiresolution or multiscale analysis, and signal analysis in this way is also called sub-band coding.

In fact, in wavelet transform, like Fourier transform, a time-based function is expressed as a set of sentences with base wavelet functions, except that the wavelet function is not like sin and cos and contains a scale parameter.

Considering that the approximation coefficients include low frequency information and the general trend of the time series, it is necessary to select the layer that is most similar to the original signal from among the layers of approximation coefficients, and based on that, the optimal time horizon for holding shares to investment should be suggested.

The SSIM criterion (Structural Similarity Index Matlab) calculates the similarity coefficient, which examines the structural similarity based on the intensity of fluctuations and noises. In fact, with this criterion, we calculate the similarity between the original signal and the approximation coefficients to obtain the optimal time horizon of fluctuations. If the degree of similarity is high, this criterion approaches 1; if the similarity is very low, That approaches zero. The higher noise causes a decrease in this criterion.

$$ssim(x,\ y) = \frac{(2\mu x\ \mu y + c1)(2\sigma xy + c2)}{(\mu^2 x + \mu^2 y + c1)(\sigma^2 x + \sigma^2 y + c2)}$$

- μx:Average of approximation coefficient
- μy: The average of the studied time series
- $\sigma^2 x$: The variance of the approximation coefficient
- $\sigma^2 y$: Variance of the studied time series
- σxy: The covariance between the approximation coefficient and the studied time series
- *C1* و *C2* : constants for stability. (Wang et al., 2021)

4. Research results

The results of the first hypothesis test:

4.1 Wavelet variance analysis of stock returns

To analyze the data related to the variance of stock returns using wavelets, first, the data related to the total index are decomposed into 12 layers of approximation coefficients and 12 layers of detail coefficients. The number of layers is determined according to the complexity of the time series. The more complex the time series is, the more layers are needed to describe the data; therefore, the analysis of layers proceeds until the coefficients of approximation related to the last layer become zero and the coefficient of detail of the last layer becomes a simple wavelet pattern. The symbol denotes the approximation coefficients and the detail coefficients are denoted by the symbol d. The algorithm of decomposition of the main function into coefficients of approximation and coefficients of detail is such that in the first layer, the main function is decomposed into a1 and d1 and in the second layer, a1 is decomposed into a2 and d2 and this signal decomposition continues until the twelfth layer. The Diagrams For The Coefficients Of These 12 Layers Are Shown In The Figure (1):

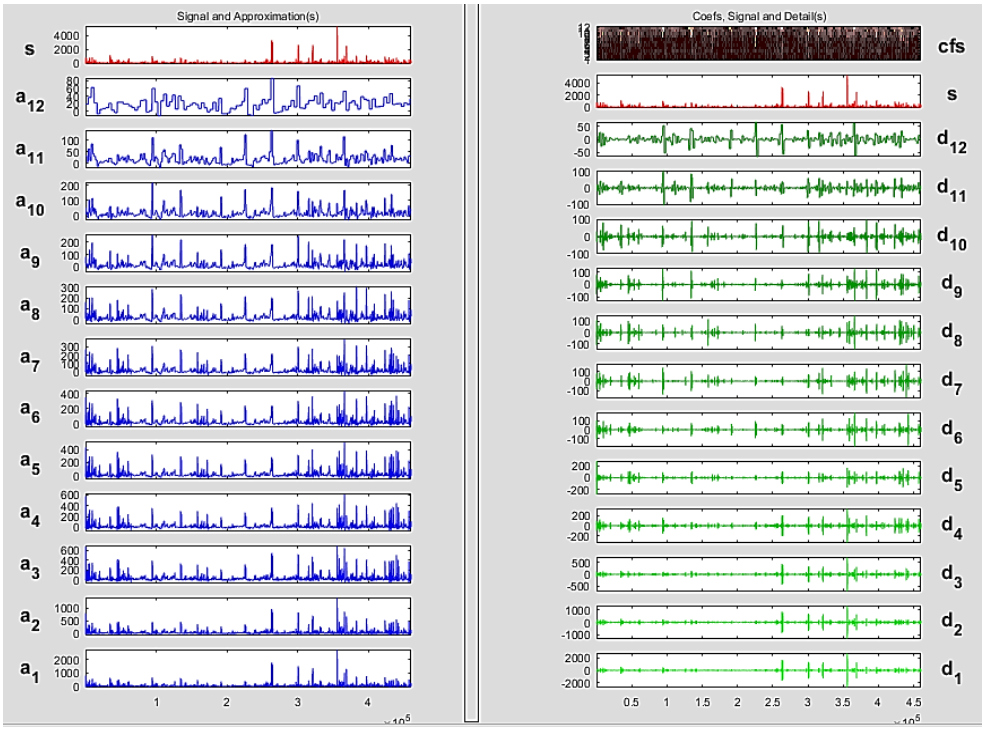

Figure 1. Diagrams related to approximation coefficients and detail coefficients in 12 layers

According to the diagrams above, the initial layers represent the signal's high frequency details, and the final layers describe the signal's low frequencies. The signal is displayed longer as we move from the initial to the final layers. In general, approximation coefficients show the trend of fluctuations longer than detail coefficients. The fastest dynamic corresponds to d1 and the slowest dynamic corresponds to the last layer. The detail coefficients examine the signal in a very short time. As seen from the above Figure (1), long-term regressions are approximated by layers of coefficients of approximation and short-term regressions are approximated by layers of detail. Table (1) shows the standard deviation and wavelet variance of each layer :

Table 1. Standard deviation and comovement variance of the industries at different time scales

Layer number	The standard deviation of approximation coefficients	Variance of approximation coefficients	Standard Deviation of Detail Coefficients	Variance of Detail Coefficients
1	57.607	3318.780	39.409	1553.190
2	50.358	2536.990	27.975	782.694
3	46.620	2173.590	19.037	362.467
4	44.877	2014.001	12.630	159.556
5	43.921	1929.155	9.209	84.839
6	43.030	1851.690	8.802	77.498
7	41.466	1719.590	11.491	132.069
8	39.394	1552	12.945	167.608
9	36.096	1303.100	15.775	248.909
10	31.058	694.540	18.360	337.140
11	23.850	568.870	19.905	396.267
12	17.058	291.015	16.668	277.861

Based on Table (1), the coefficients of approximation and detailed coefficients of variance of the stock returns volatility are given. As you can see, the coefficients of approximation of stock return volatility at smaller scales are lower, but with the increasing scale, the variance is reduced. This means that volatility about the mean of the short-term to long-term stock returns is lower. However, with the increasing scale, variance declined in the medium term, and in the long run, this deviation slightly increased and then decreased.

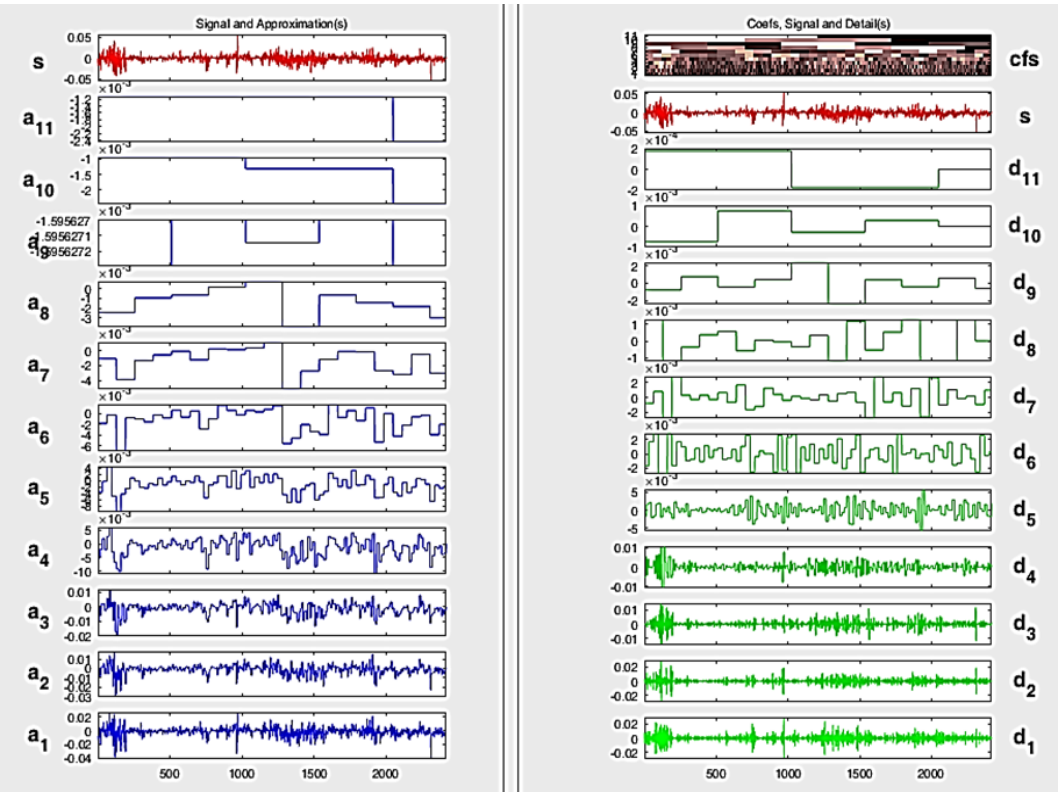

Figure 2. Diagrams of approximation coefficients and detail coefficients in 11 layers

4.2 Wavelet Variance Analysis Of the moving average of stock returns

The relevant data are decomposed into 11 layers of approximation coefficients and 11 layers of

detail coefficients to analyze data on the Wavelet Variance Analysis of the moving average of stock returns. The first is exploited to extract long-term behavioral patterns, and the second is used to extract short-term behavioral patterns.

The diagrams for the coefficients of these 11 layers are shown in the Figure (2):

According to the diagram above, the initial layers represent the details of the signal's high frequency, and the final layers describe the low frequency of the signal. The signal is displayed longer as we move from the initial to the final layers. In general, approximation coefficients show a trend of fluctuations longer than detail coefficients. In fact, the fastest dynamic corresponds to d1 and the slowest dynamic corresponds to the last layer. The detail coefficients examine the signal in a very short time. As the above figures illustrate, the coefficient layers approximate long-term regressions and short-term regressions are approximated by the coefficient layers. Table (2) shows the standard deviation and variance of each layer:

Table 2. Standard deviation and comovement variance of the moving average of stock returns at different time scales

Layer number	The standard deviation of approximation coefficients	Variance of approximation coefficients	Standard Deviation of Detail Coefficients	Variance of Detail Coefficients
1	53.257	2837.363	28.673	822.197
2	48.595	2362.436	19.117	365.496
3	43.147	1862.516	15.361	235.990
4	39.354	1549.514	11.267	126.966
5	37.215	1385.690	8.484	71.994
6	34.972	1223.730	7.420	55.070
7	30.321	919.959	12.363	152.867
8	25.403	645.811	16.991	288.727
9	23.944	573.784	19.101	364.885
10	17.537	307.887	23.511	552.813
11	15.672	245.915	27.700	767.344
12	12.763	163.139	29.102	846.983

Based on Table (2), the coefficients of approximation and variance coefficients of the details of volatility and changes in the moving average of stock returns are given. The variance was used in the logarithm of variance for a better appraisal. As can be seen, stock returns moving average volatility approximation coefficients have been increased at fewer scales, but with the increasing scale, the variance is reduced. This means that the volatility of the short-term moving average in stock returns over the long-term average is less. Since variance in stock returns moving average at fewer scales (short-term) increased with increasing scale, the variance is much reduced in the medium term, and in the long run, this deviation increases again.

Table 3. Comparison of standard deviation and variance of stock returns wavelet wave and moving average stock returns

Stock returns	69.798	Standard deviation
	4871.960	Variance
Moving average stock returns	80.000	Standard deviation
	6400.158	Variance

As seen from Table (3), given that the amount of variance in stock returns is greater than the moving average of stock returns, then the fifth hypothesis of the research is accepted. Likewise, based on the moving scales of each stock return and the moving average of stock returns in Tables (1) and (2), they had less wavelet variance and less comovement during long-term scales, but over

short time scales, the movement increased and the variance of the wavelet efficiency was higher among them.

4.2.1 The similarity coefficient between the original signal and the wavelets of different time layers

Table 4. The similarity coefficient between the original signal and the wavelets of different time layers

	The highest SSIM similarity index value among approximation coefficients	Layer number of optimal approximation coefficient	Optimal time horizon
Volatility of stock returns	0.961	A5	32-64
The volatility of the moving average of stock returns	0.970	A6	64-128

According to the results of Table (4), the approximation coefficients related to the fifth and sixth layers have been able to have a higher similarity and movement with the fluctuations of stock returns and the fluctuations of the moving average of stock returns, and among other time levels, they are more optimal time horizons to hold Stocks and invested.

Given the first hypothesis of the research, which is about the higher frequency coefficient and fluctuations of stock returns compared to the moving average of stock returns, because the amount of variance of stock returns is more than the moving average of stock returns, therefore the first hypothesis of the research is accepted; Also, according to the fluctuations in each of the scales of stock returns and the moving average of stock returns, during the long-term scales, the wavelet variance has been less and less comovement.

4.3. Test results of the second hypothesis

4.3.1 Wavelet Analysis of the moving average of the total index

The data related to the moving average of the total index is analyzed using wavelets. First, the relevant data are decomposed into 12 layers of approximation coefficients and 12 layers of detail coefficients. Long-term behavioral patterns are extracted using diagrams and coefficients of approximation layers, and short-term behavioral patterns are extracted using diagrams and layers of detail coefficients. Now, these data are analyzed using the wavelet.

The graphs related to the coefficients of these 11 layers are shown in the Figure (3):

According to the diagram above, the initial layers represent the details of the signal's high frequency, and the final layers describe the low frequency of the signal. The signal is displayed longer as we move from the initial to the final layers. In general, approximation coefficients show a trend of fluctuations longer than detail coefficients. The fastest dynamic corresponds to d1 and the slowest dynamic corresponds to the last layer. The detail coefficients examine the signal in a very short time. As can be seen from the above figures, long-term regressions are approximated by coefficient layers and short-term regressions are approximated by detail layers. Table (5) shows the standard deviation and variance of each layer:

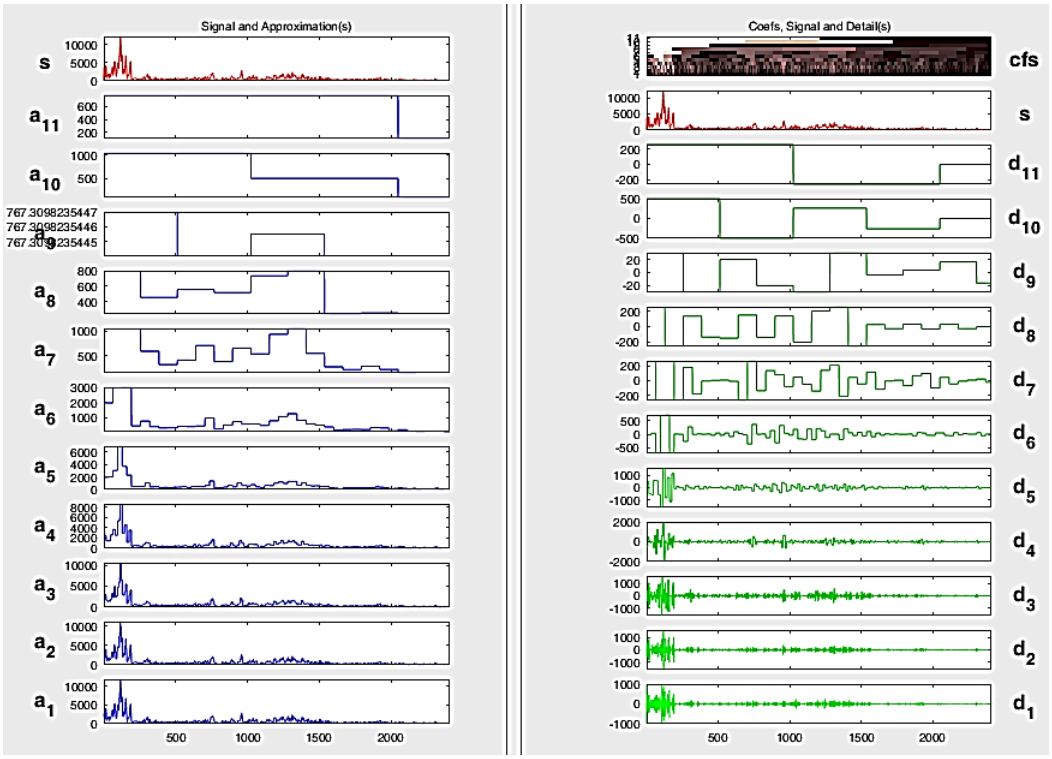

Figure 3. Diagrams of approximation coefficients and detail coefficients in 111 layers

Table 5. Standard deviation and comovement variance of the moving average of the total index at different time scales

Layer number	The standard deviation of approximation coefficients	Variance of approximation coefficients	Standard Deviation of Detail Coefficients	Variance of Detail Coefficients
1	53.743	2888.417	36.371	1322.921
2	50. 963	2597.328	30.404	924.463
3	47.839	2288.665	28.173	793.773
4	45.101	2034.189	22.711	515.834
5	40.326	1626.266	18.202	331.348
6	38.540	1485.408	15.347	235.560
7	31.503	992.501	10.844	117.613
8	25.680	659.513	9.214	84.917
9	22.442	503.687	7.302	53.332
10	17.529	307.300	6.284	39.595
11	12.767	163.021	5.928	35.150
12	8.783	77.158	4.315	18.626

Based on the table above, the wavelet variance and investment risk are reduced as we move from the initial to the middle layers. According to Figure (3) and the results of Table (4), the variance of the coefficients of approximation and the coefficients of the details of the volatility and changes of the moving average of the total index are given. It was used for a better review and to observe the variance in the logarithm of variance. As can be seen, the coefficients of approximation of the volatility of the moving average of the total index lower scale increases, but the variance is reduced with increasing scale.

Table 6. Comparison of standard deviation and variance of total index wavelet returns and moving average of the total index

Standard deviation	102.120	Overall Index
Variance	10428.425	Variance
Standard deviation	1093.80	Moving average of the total index
Variance	1196400	Variance

As it is clear from Table (6), since the amount of variance of the moving average of the total index is more than the total index, the second hypothesis of the research is rejected. Likewise, based on the movement scales of each of the total indexes and the moving average of the total index in Tables (4) and (5), they had less wavelet variance and less movement during long-term scales. Still, both comovement and wavelet yield variance were more common during short-term time scales.

4.3.2 The similarity coefficient between the original signal and the wavelets of different time layers

Table 7. The similarity coefficient between the original signal and the wavelets of different time layers

	The highest SSIM similarity index value among approximation coefficients	**Layer number of optimal approximation coefficient**	**Optimal time horizon**
Fluctuations of the total index	0.964	A6	64-128
Fluctuations of the moving average of the total index	0.921	A8	256-512

According to the results of Table (7), the approximation coefficients related to the sixth and eighth layers have been able to have a higher similarity and comovement with the fluctuations of the total index and the fluctuations of the moving average of the total index, and among other time levels, they are more optimal time horizons for maintenance Stocks and investment.

The second hypothesis of the research is about the higher frequency coefficient and fluctuations of the total index compared to the moving average of the total index; because the amount of variance of the moving average of the total index is more than the total index, the second hypothesis of the research is rejected. Also, according to the movement scales of each of the total index and the moving average of the total index, during the long-term scales, the wavelet variance was less and the movement was less, but during the short-term time scales, the movement increased and the wavelet variance of the return among them has been more; Therefore, considering that the amount of fluctuations and the frequency of the moving average of the total index is much higher than the total index, the second hypothesis of the research is rejected.

5. Conclusion and discussion

According to the first hypothesis of the research, which is about the higher frequency coefficient and volatility of stock returns than the moving average of stock returns, since the variance of stock returns is more than the moving average of stock returns, the first hypothesis of the research is accepted. Similarly, regarding the moving scales, each of the stock returns and the moving average of stock returns during the long-term scales had less wavelet variance and less comovement. Still, over short time scales, the movement increased, and the variance of the wavelet return was higher between them. According to the second hypothesis of the research, the frequency coefficient and volatility of the total index are higher than the moving average of the total index, considering that the amount of variance of the moving average of the total index is more than the total index, so the

second hypothesis of the research is rejected. Likewise, according to the movement scales of each of the total indices and the moving average of the total index during long-term scales, the wavelet variance was less and had less comovement. Still, over short time scales, there was more comovement and the variance of the wavelet efficiency was higher between them.

Based on the analytical results of this research, traders are suggested to pay more attention to analytical methods based on moving averages to analyze and develop their trading strategies in the short term and give more points to the price and yield of the shares in the long term to analyze their trading methods and formulate their strategies based on the stock price and return. Also, due to the higher wavelet variance of the return in the short term and its lower in the long term, non-professional traders can choose short- and long-term investments based on their strategy. Given the comparison of the wavelet variances of the stock return and the moving average of stock returns in different time scales and based on the degree of similarity of each of these two variables with the wavelet variance of the approximation coefficients, the fifth and sixth layers are the optimal layers for making decisions in Fluctuations were selected. Based on the obtained results and considering that the wavelet variance of the stock return is lower than the variance of the moving average of the stock return, it is suggested that traders should use methods based on the price itself, such as price action methods, in their forecasts. Also, based on the SSIM similarity criterion between the main signal with the approximation coefficients related to stock returns and the moving average of stock returns, it is suggested that traders who aim for long-term investment should consider the fifth and sixth levels of the time horizon to hold stocks. For traders who want to act in the short term, give more weight to price-based analysis methods to determine their trading strategies and use technical analysis methods to identify their entry and exit points. Medium-term shareholders can also use a combination of price-based and moving average methods (by assigning more weight to price-based methods). Based on the results of the layer analysis, it seems that long-term investment is not justified. However, the strategy of real people is different from that of investment institutions on different time horizons. However, the logical solution seems to be to sell shares after the end of an upward trend and temporarily exit the market during the recession, a period of correction and extreme erosion. In general, by comparing the variances of the total index and the moving average of the total index and examining the similarity indices between the main indices and the approximation coefficient, the sixth time layer for the total index and the eighth time layer for the moving average of the total index were selected as optimal time horizons have been and the characteristics can justify this reason for the difference in the optimal time layers compared to the original price. According to the lower wavelet variance of the total index compared to the moving average of the total index, it is suggested that analysts and traders allocate a greater share to the fluctuations of the total index in their analyses and make decisions based on price-based analytical methods such as price action and Fibonacci. Also, they can invest in index-making stocks in the optimal period (sixth-time level). Also, based on the research results, it is suggested that beginner traders adjust their strategies based on the optimal time layers obtained for each of the analyzed variables, which were usually medium-term, and professional traders should choose A combination of short-term and long-term investments.

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Cultural Intelligence and Intellectual Capital: Evidence from External Audit Firms

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Abstract

Intellectual capital (IC) is acknowledged as a strategic advantage for improved performance, and cultural intelligence (CI) is becoming a more significant asset for managers, employees, entrepreneurs, and their organizations. This paper aims to present a new framework for managing IC within audit firms, considering the perspective of CI. The method of the present study is a descriptive survey in terms of data collection and applied from the standpoint of purpose. The statistical population of this study includes all auditors working in audit firms under the membership of the Society of Certified Public Accountants, and 319 individuals made up the statistical sample. The partial least squares approach was used to conduct structural equation modeling, which examined the impact of research variables on IC and fitted the suggested model. According to the study's findings, CI has a positive and significant relationship with the human, structural, and relational elements of IC and auditors will have more human capital (HC), structural capital (SC), and relational capital (RC) as IC rises. The research is exploratory and the framework offers opportunities for refinement. Future studies are required to confirm the framework's applicability to other organizations intended to serve as CI systems. Contribution to the IC research literature is highlighted, expanding the concept of IC value creation beyond the audit firms into wider society and developing a new perspective for managing IC in the audit firms adopting the CI approach. The framework can be used to manage IC strategically in all the systems interpreted as CI systems in which the role of IC creation from multiple actors is relevant. This makes comprehending how IC helps the region and society where the audit firms operate possible. This study is paramount since limited empirical evidence exists, particularly in developing/underdeveloped countries worldwide. The paper's originality lies in combining topics typically covered by literature in different fields, such as IC management and CI perspective. The CI approach provides a novel contribution to managing IC and is intended to inspire future research.

Keywords:
Cultural Intelligence, Human Capital, Intellectual Capital, Relational Capital, Structural Capital

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1. Introduction

The global community needs the existential philosophy of the auditing profession. Auditors are necessary for society and the general public to receive attesting services and for auditors to maintain, survive, and carry out their duties. As a result, auditors play a crucial role among those in each society who are affected by it and have corresponding effects on it. As a result, auditor performance directly or indirectly impacts other crucial facets of the Accounting Information System (AIS) and the caliber of financial reporting, affecting all spheres of society. As a result, to accomplish its objectives, the auditing profession must choose and develop its human resources (which are its most important resources and, in fact, valuable IC) in a way that ensures that not only does the level of their intelligence and IC not negatively impact society, but that all members of society also profit from the benefits of achieving audit goals. International business is significantly challenged by environmental hazards and uncertainties, cultural and regulatory differences, and these factors (Aharoni et al., 2011). Coping with such institutional environmental dynamism and challenges requires a considerable share of senior managers' work and is a vital determinant for success and failure (Henisz and Swaminathan, 2008). In recent decades, audit firms have engaged in an important transformation process to make them more autonomous, economically efficient and competitive. This transformation is taking place in the context of social, economic, cultural, and political change, in which the audit firms are moving towards an organizational model that is more consistent with the promotion of economic development and in synergy with institutions and industries. This paper aims to combine the perspective of CI with IC management, developing a new practical framework that incorporates how IC can be managed and created in audit firms to increase the audit firm’s impact on society.

Iran is made up of a variety of ethnic ethnicities, each of which has its own cultural environment. These institutions, which usually draw their human elements, both personnel and managers, from the country and beyond, are likely to be culturally diverse due to their multi-ethnic and multicultural makeup. Akpan and Inyang (2018) contend that a workplace with diverse cultures should allow for some degree of inclusiveness to improve workers' job performance. They clarified that this inclusivity necessitates CI and should consider various factors, including language, cultural norms, religion, genealogy, and social class.

Here, "CI" refers to people's capacity to function well in situations defined by cultural diversity and their ability to successfully adjust to new and unfamiliar cultural settings (Ang et al., 2015). In particular, it is a type of non-academic intelligence that shows a person's capability to operate easily in settings representative of various cultural backgrounds. In contrast to other non-academic intelligence, like emotional intelligence, which is culture-specific and does not translate across the cultural spectrum in today's multicultural workplaces, it includes a collection of mental, motivational, and behavioral skills (Presbitero, 2016). Cultural intelligence can improve job performance when used to recognize and manage cultural differences within a company.

Two topics have received the majority of attention in recent studies on CI. First, several people have talked about how the workplace is changing, how mono cultural organizations are generally declining, and how modern organizations are becoming more multicultural. These articles often offer anecdotal proof of the importance of CI in assisting workers in these businesses to deal with the difficulties posed by cultural diversity. Second, a different line of research has examined how cultural savvy among expats affects worker performance. According to the literature, CI among expatriates results in improved performance. Yet, both sets of studies focused on international judgments of CI rather than the fact that CI is multidimensional. According to earlier conceptualizations, the four components of CI are metacognitive, cognitive, motivational, and behavioral. This research focuses on the effect of the different dimensions on the job performance

of academic staff in tertiary institutions in Iran. Among the key principles of the audit firm, the engagement of auditors to achieve the goal is more pressing today than in the past. Audit firms have moved from focusing exclusively on their traditional teaching and research missions towards a more active role in economic and cultural growth.

Recent reviews of the IC literature find that the audit firm is one of the least researched IC areas. Therefore, what researchers classify as services is continually evolving and will continue to evolve. Thus, there is a lack of IC research about audit firms, given the differences between it and other economic sectors and the continued blurring of the lines between public and private services that create value for citizens. Therefore, audit firms' IC research is an area worth exploring, especially in the context of the change in how these services are delivered and paid for. Additionally, some researchers "stress how important it is for future audit firms' IC research to address important and innovative current issues such as the changes in education" The distinguishing features of the new audit firm raise the problem of identifying proper frameworks for managing and analyzing IC performance, particularly in terms of IC and knowledge assets culturally generated by all the audit firm auditors and their impact within the wider societal and regional ecosystem. The concept of IC has recently been categorized differently by academics and business management. IC is a dynamic system of intangible, knowledge-based resources and activities capable of creating value for the auditors. IC has been described as intellectual material that has been formalized, captured and leveraged to produce a higher valued asset. An interesting conceptualization sees IC as the combination of intangible resources and activities that allows an organization to transform a bundle of material, financial and human resources into a system capable of creating auditor value and organizational innovation. However, the tripartite classification is the most widely accepted in the IC literature, in which IC is structured in three blocks: HC, SC and RC. It is important to note that the real value from IC resides in the sum of the elements that make up the whole and in the interconnections between them.

Generally, the activities comprise three dimensions in which audit firms engage externally: technology transfer and innovation, continuing education, and social engagement. This has been motivated by auditor demand for greater transparency, increasing competition between audit firms, greater autonomy, and the push by audit firms towards adopting new management and performance systems incorporating intangible assets and IC. The original motivations of the present study have been identified per the mission of the audit firm, inspired by CI. These are competence development, the highest purpose of the audit firm and affecting the development of capacities and skills of its HC, characterized by a mindset dedicated to innovation and development; technology transfer and innovation linked to the concept of capacity for action and achievement of development and innovation, with the logic of cost minimization and social engagement and regional development: the transmission of knowledge together with the development of entrepreneurial and intellectual skills creates wealth and development in the regional ecosystem.

2. Literature review

2.1. Cultural intelligence

CI evolved from theories and research on emotional and social intelligence. Still, previous research on these types of intelligence did not adequately address the complexities of working in cross-cultural contexts (Van Dyne et al., 2008). They introduced the construct of CQ based upon the gap in the literature that interpreted and explained culturally-based decision-making and behavioral differences in types of intelligence. They defined CI as the ability to recognize new patterns in cultural interactions and respond appropriately to these patterns. According to Ang et al. (2007),

cultural intelligence is a specific form of intelligence focused on learning, evaluating, and behaving effectively in different situations characterized by cultural diversity. It is a multidimensional construct that allows an individual to continuously learn and coexist with people from other cultures. It is composed of four intelligence bases: metacognitive, which refers to an individual's awareness of interactions with people from other cultures; cognitive, which refers to the specific knowledge one has about the rules, habits, and conventions in new cultural backgrounds; motivational, which captures an individual's motivation to learn and act effectively in various situations; and behavioral, which is conceptualized as an individual's flexibility (Chen, 2015). Metacognition, cognition, and motivation are all within the head as mental capabilities, whereas behaviors manifest as explicit actions.

CI is the ability to become adaptable to understand other cultures, learn from ongoing interactions, and gradually reshape one's thinking. A person's ability to successfully adapt to unfamiliar cultural settings goes beyond general cultural knowledge. Due to increased globalization, CI is becoming a preferred skill among leaders and becoming even more important in a digital setting. The emphasis is gradually shifting away from leadership training and toward organization-wide training. According to research, CI has four dimensions: cognitive, metacognitive, motivational, and behavioral. Cognitive cultural intelligence is an individual's understanding of cultural values, norms, and beliefs. It entails a comprehension of cultural differences as well as cultural universals. Cultural differences are characteristics that differ across cultures, whereas all cultures share cultural universals. The ability to be attentive, pick cues from cross-cultural interactions, and reflect on existing knowledge to modify it is called metacognitive CI. People with a high level of metacognitive CI understand how culture influences behavior (Dyne et al., 2012). Being mindful during intercultural interactions is critical because it allows one to consciously apply cultural knowledge. Individuals with motivational CI are interested in and confident in cross-cultural interactions. Self-efficacy and intrinsic motivation are regarded as critical components of cross-cultural interaction success. Motivational CI has also been shown to improve cultural effectiveness. The ability of an individual to exhibit a set of verbal and nonverbal actions when interacting with people from different cultures is referred to as behavioral CI. People with high behavioral and CI can adapt their behavior patterns. It forecasts individuals' cultural adaptation and task performance.

2.1.1. Metacognitive intelligence

Metacognitive CI is the ability to acquire and comprehend cultural knowledge. As such, metacognitive CI reflects the ability to consider prevalent cross-cultural assumptions and modify them as necessary, thereby assisting individuals in having a better understanding of their cultural preferences both before and during cross-cultural exchanges (Eisenberg et al., 2013). According to Chen et al. (2011), people with high metacognitive CI are more aware of how their culture influences their behavior and understanding of intercultural situations. Self-awareness, other-awareness, and situational awareness are all part of this awareness.

Specific metacognitive self-regulated mental processes are mentioned to understand the nature of metacognitive CI. These are planning, being aware, and checking. Planning has a strategic foundation and is initiated prior to encountering another culture. Before taking action, it is necessary to think about culture and reflect on what needs to be done. In real-time, awareness is aware of cultural thinking and knowledge of oneself and others. Chen et al. (2014). While planning refers to accepting consciousness, awareness refers to people's real-time understanding of how culture influences their mental processes and behaviors, as well as the mental processes and behaviors of others in intercultural interactions and situations. When experience does not match

expectations, checking entails reviewing assumptions and adjusting mental maps. It employs contrasting the expected and actual outcomes of intercultural communication. All three sub-dimensions of metacognitive CI prompt a person with high metacognitive CI to plan, reflect on the situation during the actual contact, and adjust behavior accordingly.

2.1.2. Cognitive intelligence

Cognitive CI is the accumulation of general cultural knowledge and cultural differences. The perception of cultural environment elements leads to understanding how the system arranges patterns of behavior and interactions within a culture and why behaviors and interactions differ across cultural settings. This general knowledge is divided into two categories: cultural general knowledge and context-specific knowledge.

Culture-general knowledge is understanding the universal elements that make up a cultural environment. It provides an essential organizational framework for considering potential methods of comparing different cultures and comprehending the similarities and differences. Context-specific knowledge concerns informative knowledge about how cultural characteristics manifest in a specific environment and procedural knowledge about how to be effective in that environment. A business environment, diplomatic environment, peacekeeping forces, educators, or demographic subgroups based on gender, age, and education are all examples of environments or domains. Individuals working in multicultural tertiary institutional settings must be well-versed in the norms and expectations of these subcultures to perform effectively. Context-specific knowledge refers to an insider understanding of operating within a specific environment. In contrast, culture-general knowledge refers to a broader comparison across cultures based on outsider understanding and comparisons (Morris et al., 1999).

2.1.3. Motivational intelligence

The ability to direct attention and energy toward learning about and functioning in culturally diverse situations is reflected in motivational CI. Engle and Crowne (2014) state that such motivational capacities control cognition and behavior, facilitating goal achievement. The expectancy-value theory of motivation states that the direction and magnitude of energy directed toward a specific task are determined by the expectation that the task will be completed and the value associated with completing the task (Du Plessis, 2011). Those with high motivational CI direct their attention and energy toward cross-cultural situations because they are intrinsically interested in cross-cultural effectiveness (Guðmundsdóttir, 2015).

2.1.4. Behavioral intelligence

The ability to exhibit appropriate verbal and nonverbal actions while interacting with people from different cultures is reflected in behavioral CI. Sub-dimensions of behavioral CI include verbal, nonverbal, and speech acts. The term "verbal behavior" refers to vocalization flexibility. A person's behavior can be modified by altering the pace of their speech, the amount of warmth or enthusiasm they display, or the use of pauses or silence. Nonverbal communication is using gestures, facial expressions, and body language to communicate. Some cultures are more expressive than others in nonverbal communication. A non-local outsider's task is to learn appropriate nonverbal communication methods through metacognitive CI and adjust his or her behavior accordingly.

2.2. Intellectual capital

IC theory has been widely used since the last decade (Cheng et al., 2010). Cheng et al. (2010).

According to the initial definitions, "intellectual action" is something other than "pure thinking." This stance implies that IC is a more dynamic ideological process than fixed capital (Hang Chan, 2009). IC is a multidisciplinary concept with various interpretations in business and commerce (Hwanglee, 2010). According to the definition, IC is the ability of intangible resources to create and sustain a competitive advantage. In reality, IC refers to the knowledge available in an organization on two levels: individual and organizational. Individual level knowledge, skills, and talent; organizational level includes each customer's specific database, technology, methods, and organizational processes (Joshi and Ubha, 2009). IC is generally defined as a collection of intangible assets, also known as knowledge assets (Sudarsanam et al., 2006). This type of capital provides a new resource for the organization to compete with (Bontis et al., 2002), and it includes that portion of the organization's total capital or assets that is based on knowledge and that the organization owns (Anvari and Seraji 2005). Others define IC as organizational resources related to wealth creation via investment in knowledge, information, intellectual property, and experience (Stewart, 1997). According to the Stewart Model," IC has HC and relational dimensions. HC is the foundation of IC and is regarded as a critical component in carrying out its responsibilities. HC refers to human members' capabilities, skills, and expertise that create valuable assets for the organization. SC refers to an organization's non-human reserves and knowledge, such as databases, organizational charts, instructions for implementing processes, strategies, executive programs, or anything else that has a higher value for the organization than its material values. Organizational culture, organizational learning, operational processes, and information systems are all examples of SC. RC is all resources related to the business entity's external communications, including relationships with customers, suppliers, and participants in research and development projects. Many experts classify IC into three categories (Tayles et al., 2007; Marr, 2008):

HC includes employees' knowledge and skills, as well as their professional experience, expertise, level of education, and creativity. SC includes databases, software systems, distribution networks, organizational charts, common cultures, strategies, and policies;

Marketing networks, customer communications, customer loyalty, governmental and industrial networks, and contacts or partners are all examples of RC.

In today's dynamic and risky international communication, auditors must obligate themselves to adhere to cultural values and, as a result, acquire CI and create IC to ensure the auditing profession's survival. This process will improve the quality of services auditors provide, ultimately satisfying members of society and ensuring the auditing profession's survival. Auditors with higher levels of CI will be more valuable intellectual assets to the auditing profession. As a result, auditors with higher intelligence are expected to have a greater sense of responsibility, and their actions will be more consistent with their values and beliefs, resulting in higher performance. Intelligence, experience, auditing and accounting standards, auditing guidelines, the ability to defend, non-bias of decision, doubt, and independence of the auditor (as influencing factors on reasoning) at various levels, adherence to ethics, cultural principles free of fraud, knowledge and skill in the desired industry, and openness and transparency of information are all factors that can improve auditors' reasoning.

Organizations, particularly professional institutions such as the auditing profession, are experiencing extensive and increasing changes in cultural, economic, social, educational, and technological issues, as well as spiritual teachings and beliefs. If auditors respond quickly to changes and developments, they can solve issues and problems. Human resources and the management of IC in providing and promoting human resources, which aligns with auditors' personal characteristics and intelligence, are two of the most important factors that should be considered significant in the auditing profession. We will not be able to deal effectively with new

problems if we apply structures, attitudes, and knowledge that have been useful in the past, as "Einstein" warned (Marquardt, 2002). Thus, applying and focusing on the dimensions of CI can result in a massive transformation of the auditing profession. Despite the importance of these aspects of intelligence in the creation of IC, more attention should be paid to their role because intelligence awareness can help do better in the processes of hiring, transferring, and promoting auditors, which will lead to a decrease in auditor turnover and, eventually, an increase in their job satisfaction and performance. On the other hand, IC is recognized as a strategic asset for improved performance, and IC management (ICM) is critical to an organization's competitiveness (Moghimi and Ramezan, 2011).

A review of previous research on IC in the auditing profession revealed that no effective activities have yet been carried out in this field, and the scattered and limited works done in this regard indicate that IC in various dimensions can be influenced by various factors such as organizational behavior, individual characteristics, intelligence, and so on. Because moral motivations can play an important role in paying attention to the human aspects of IC, organizations, businesses, and various professional institutions, including the auditing profession, are expected to perform their duties competently, appropriately, and even better to strengthen IC. However, the inappropriate state of IC and its components prevails and initially comes to people's, society's, and stakeholders' minds.

Where auditors see the benefits of remote auditing, they value the degree of adaptability and work efficiency that teleworking provides. Audit firms will see improved audit activity outcomes if they embrace emerging technologies in the new digital workplace. Nonetheless, as the transition to remote audit increases auditor liability and audit risks, auditors are more cautious and, in some cases, hesitant about future scenarios of remote audit if innovative emerging audit technologies and integrated governance, risk management, and compliance (GRC) are not used or are not properly implemented. Whatever the future holds for the new digital audit workplace, it is clear that auditors working from home face unique challenges because what they gain in efficiency is offset by benefits that are more difficult to quantify, such as innovative thinking and creativity (Farcane et al., 2023). According to recent research findings, higher levels of CQ are associated with supportive and culturally sensitive strategies, active participation in the host environment, the importance of intrinsic motivation, and the ability to appropriately adjust behavior. Furthermore, academics with higher levels of CQ were found to have important capabilities such as engaging local actors and embracing local culture and people (Tharapos and O'Connell, 2023). Work engagement mediates both the relationship between expatriates' CQ and task performance and the relationship between expatriates' CQ and premature return intention. Cultural distance moderates the positive relationship between CQ and work engagement, as well as work engagement's mediating effects (Chen et al., 2024). An exploratory study found that motivational CI positively and significantly affect cultural adjustment (work adjustment, general adjustment, and interaction adjustment, in that order). That cultural distance negatively moderates motivational CI and work adjustment for expatriate talent (Song et al., 2023).

The results of a recent research hypothesis test revealed that the limitations of accrual-based earnings management and the efficiency of IC influence asymmetric cost behavior. Indeed, the findings confirm that the limitations of accrual-based earnings management increase asymmetric cost behavior and cost stickiness. In contrast, the efficiency of IC, particularly the HC and SC coefficients, increases cost stickiness and asymmetric cost behavior. The findings also revealed that the physical capital coefficient reduces cost stickiness and asymmetric cost behavior (Badiei et al., 2023). A recent study found that RC is important in adopting open innovation. Indeed, RC positively and significantly impacts the three open innovation practices investigated: openness to

external sources of information and knowledge, R&D collaborations, and other incoming activities (Elbouzidi, 2023).

According to a recent study, high levels of CI positively impact an individual's innovative behavior. Furthermore, interpersonal trust levels would moderate CI influence on individual students' innovative behaviors. According to these findings, the majority of Indonesian citizen students who participated in student exchanges or studied abroad had a high level of CI. This study looked at the impact of CI on individuals' innovative behavior, also known as cross-cultural interaction. Furthermore, this study concentrated on Indonesian citizen students who participated in student exchanges or studied abroad. This type of research has not been thoroughly conducted or even discussed in academic circles. As a result, it was necessary to contextualize this issue within the context of science education and management science (Kistyant et al., 2022). Another study found that perceived management CI significantly positively affects pro-diversity climates. Climates supportive of diversity are also negatively and significantly associated with perceived discrimination. Furthermore, a pro-diversity climate fully mediates the effect of perceived management CI on perceived discrimination. This study demonstrates that ensuring top management has CI may not be enough for a company to successfully address workplace discrimination. Rather, top management must foster an organizational climate that values the racial diversity of foreign migrant employees (Charoensukmongkol and Phungsoonthorn, 2022). A recent study found that having or studying CI is important. CI will greatly aid us in communicating and expressing various ideas and mindsets of people from other cultures, resulting in innovative work behaviors and creative solutions (Neslon et al., 2022). According to a recent study, managerial ability is significantly and negatively associated with the overall extent of IC disclosure and all three components of IC (HC, SC, and RC). Further analysis reveals a positive and significant interaction between managerial ability and firm performance, implying that the negative relationship between managerial ability and IC disclosure is less pronounced for high-performing firms (Rajabalizadeh and Oradi, 2022). Another study found that the financial performance of banking companies mediated the relationship between IC and good corporate governance (GCG). Apart from good corporate governance (GCG), the only thing that can improve financial performance and corporate value is GCG, measured by the ratio of independent commissioners to audit quality. Meanwhile, the financial performance and corporate value of banking companies listed on the Indonesia Stock Exchange that are audited by the Big 4 will be greater than the financial performance and corporate value of banking companies not audited by the Big 4 (Anik et al., 2021).

According to the findings of a recent study, the seven mental patterns of managers in the direction of competent human resource selection in the post-corona era are high emotional intelligence, analytical and innovative thinking, digital skills, adaptability, intelligence skills, and active learning (Saedi et al., 2021). According to one study, there is a link between IC, organizational ethics, and organizational performance. Furthermore, IC and organizational ethics can predict organizational performance. The organization's ethics and IC are regarded as the most important organizational assets and resources for gaining a competitive advantage among organizations (Bjørnson and Dingsøyr, 2008).

Considering the CI perspective, this paper aims to provide a new framework for managing IC inside external audit firms. We are looking for a conceptual framework with a cultural perspective in the auditing profession by evaluating IC based on CI, which has not been found in any previous research, to determine the level of IC among auditors. The review of theoretical approaches suggests a set of requirements for creating and managing IC and provides the necessary components for building an integrated framework for IC practice in the audit firm. Thus, the purpose of this

section is to introduce the framework developed for the management of IC within the audit firm intended as a CI system, starting from an introduction about the audit firm's plan for a CI system and moving towards the description of the framework's main components related to management and measurement of IC. The framework aims to support the audit firm as a cultural CI in which the tangible and intellectual assets are coordinated towards achieving social engagement and regional development. The application of CI is aimed at leveraging collaboration to create more favorable conditions for managing IC within an audit firm in which involvement from both internal and external auditors of the region/ecosystem where the audit firm is located is involved. The underlying assumption of the framework is the bidirectional relationship of CI with HC, SC and RC because these components of IC create the processes and structures that bring together the audit firm with businesses and institutions. In addition, RC creates value for all audit firm members and develops CI impact for its auditors. SC creates an environment that facilitates the development of CI in the audit firm (Secundo et al., 2015). Based on these theoretical foundations and previous research, the current study intends to investigate the effects of CI on IC. The following main question is proposed: Is there a link between CI and IC?

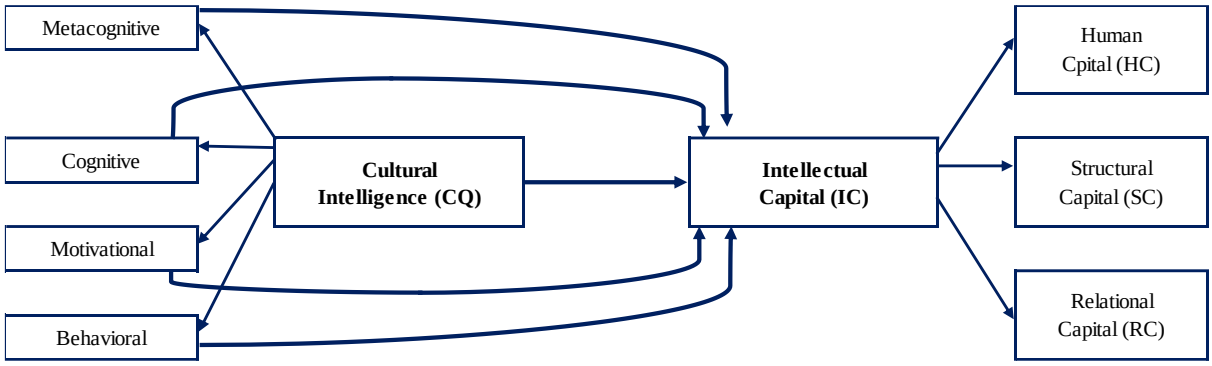

Figure 1. Conceptual model of the research

Research hypotheses are as follows by the research questions, theoretical foundations, stated backgrounds, and conceptual model in Figure 1:

H1*:* There is a significant relation between CI and IC.
H2*:* There is a significant relation between Metacognitive Intelligence and IC.
H3*:* There is a significant relation between Cognitive Intelligence and IC.
H4*:* There is a significant relation between Motivational Intelligence and IC.
H5*:* There is a significant relation between Behavioral Intelligence and IC.
H6*:* IC has a significant positive effect on HC.
H7: IC has a significant positive effect on SC.
H8*:* IC has a significant positive effect on RC.

3. Research methodology

The method of the present study is a descriptive survey in terms of data collection and applied from the point of view of purpose. The statistical population of this study includes all auditors working in auditing firms and audit organizations under the membership of the Society of Certified Public Accountants in Iran in 2022. This method is similar to multiple regression aspects because SEM methodology has been used for data analysis. The sample size determination principles used in multiple regression analysis can be applied to determining the statistical sample in SEM. The

number of samples required for Cochran's formula field research in an infinite population has been determined. The equation of the mentioned formula is in the form of the following formula:

$$n = \frac{Z^2 \alpha/2\, p(q)}{d^2}$$

Where in:
n: Number of samples
p: Success ratio in society
q: Unsuccess ratio in society
Z α/2: The value of the standard variable corresponding to the confidence level
d: Accepted error

The required number of samples was 385 participants, based on the above formula and a 5% margin of error. More paper questionnaires were distributed randomly throughout the community to observe conservatism, with 319 returned questionnaires usable and their data analyzed. Table (1) shows the demographic characteristics of the sample, including gender, age, education, and work experience of the participants in this study.

A questionnaire was used to collect data. The two questionnaires used are both standard and expert, and researchers have approved their content validity. Confirmatory Factor Analysis (CFA) and Average Variance Extracted (AVE) were used to test the convergent validity of the model structures. The factor loads of each variable must be greater than 0.4 and significant for the convergent validity test, which is used in confirmatory factor analysis using the structural factor method, so the coefficient of significance or t-value of each variable must be greater than 1.96 and less than -1.96. The Average Variance Extracted (AVE) should, on the other hand, be greater than 0.4. The minimum value for establishing reliability is 0.7 (CR for Composite Reliability), an alternative to Cronbach's alpha in structural equation analysis (Hooman, 2008). The value of composite reliability (CR) obtained in this study for research variables is greater than 0.7, indicating that the reliability of these variables can be assured.

The variables were measured using a standard questionnaire with 62 questions. To assess the variable "CI," the standard Ang and Earley questionnaire with 20 questions and four dimensions: Metacognitive, Cognitive, Motivational, and Behavioral was used. In addition, the standard Bontis questionnaire with 42 questions and three dimensions, HC, SC, and RC, was used to assess the variable IC." The responses are based on a 5-point Likert scale. There are five options, with a score of 1 representing the lowest motivation and a score of 5 representing the highest. The SEM method for testing research hypotheses employs PLS with the assistance of Excel, SmartPLS3, and SPSS26 software for data processing and statistical tests.

SEM is a statistical method that simultaneously studies the relationship of multiple variables in a pattern. One of the main reasons researchers use this approach is that SEM is a comprehensive way to test theories. Another reason is that this method considers measurement error, allowing researchers to report on their data analysis while accounting for measurement error.

4. Findings

Descriptive statistics are concerned with the arrangement and classification of data and the graphical representation and calculation of values such as mean, median, and so on, which indicate the characteristics of each member of the statistical population. The information obtained from a group in descriptive statistics describes the same group. Table (1) shows the description of the participants at the levels of each of the demographic variables:

Table 1. Demographic Characteristics of the Participants

Gender	Frequency	Percentage	Age	Frequency	Percentage
Female	92	28.840	Less than 30 years	82	25.710
Man	227	71.160	30 to 40 years	104	32.600
			41 to 50 years	97	30.410
			More than 50 years	36	11.280
Total	319	100.000	Total	319	100.000
Education	**Frequency**	**Percentage**	**Work Experience**	**Frequency**	**Percentage**
Bachelor's Degree	127	39.810	Less than 10 years	116	36.370
Master's Degree	134	42.010	10 to 15 years	73	22.880
Ph.D.	58	18.180	16 to 20 years	61	19.120
			More than 20 years	69	21.630
Total	319	100.000	Total	319	100.000

Table (2) shows the descriptive statistics for the research indicators, including the number of participants, the lowest value (Min), the highest value (Max), the Mean, Standard Deviation (SD), Skewness, and Kurtosis coefficients.

Table 2. Description of the Participants based on the Research Indicators

Variable	Min.	Max.	Mean	Std.Dev.	Skewness	Kurtosis
Metacognitive Intelligence	1	5	3.062	1.082	-0.565	-0.686
Cognitive Intelligence	1	5	3.220	0.766	-0.286	-0.474
Motivational Intelligence	1	5	3.927	0.781	0.289	-0.010
Behavioral Intelligence	1	5	2.535	0.840	0.635	-0.045
Cultural Intelligence (CI)	1.350	5	2.936	0.694	-0.016	-0.324
Human Capital (HC)	1	5	3.619	0.611	-0.697	1.456
Structural Capital (SC)	1	5	3.551	0.677	-0.682	0.927
Relational Capital (RC)	1	5	3.645	0.627	-0.938	1.916
Intellectual Capital (IC)	1	5	3.605	0.572	-0.834	1.858

Table (2) shows that CI and IC average values were 3.951 and 3.605, respectively.

The Kolmogorov-Smirnov test is used to ensure that the data is normal. The null hypothesis based on "the data distribution is normal" is tested at the 5% error level when testing the data's normality. As a result, if the test's significance value is greater than or equal to 0.05, there is no reason to reject the null hypothesis because the data is normal. The results of the data normality test revealed that the data related to the research variables is not normal. The PLS method with SmartPLS3 software was used to investigate the research hypotheses.

In contrast to the covariance-based method (LISREL, AMOS software), SEM using the PLS method lacks chi-square-based model fit indices to check the degree of conformity of the theoretical model with the collected data. This is determined by the PLS method's predictive nature. As a result, the fit indices developed as part of this approach are concerned with determining the model's ability to predict the dependent variables, such as the communality indices or the GOF index. To fit the variance-based SEM test or the PLS method, all researchers used the same framework, which is as follows: evaluation of the measurement model (outer model) that is reflective or combined; structural model test (inner model); overall model test.

A measurement model is a component of the overall model that includes questions about that component. The fit of measurement models is evaluated using three criteria: reliability, convergent validity, and divergent validity. The degree to which a measurement tool produces the same results when used under the same conditions is determined by its reliability. This means the questionnaire will be reliable if the researcher runs it again or in parallel and the results are the same. The

reliability is assessed in three ways: factor loading coefficients, Cronbach's alpha coefficients, and composite reliability.

Table 3. Reliability and Discriminant Validity and Investigating the Divergent Validity of Main Components

Variable	Met. I.	Cog. I.	Mot. I.	Beh. I.	HC	SC	RC
Metacognitive Intelligence	0.954						
Cognitive Intelligence	0.465	0.781					
Motivational Intelligence	0.621	0.507	0.848				
Behavioral Intelligence	0.529	0.335	0.681	0.868			
Human Capital (HC)	0.256	0.403	0.309	0.105	0.724		
Structural Capital (SC)	0.311	0.461	0.286	0.113	0.726	0.739	
Relational Capital (RC)	0.397	0.503	0.337	0.157	0.64	0.716	0.728
Cronbach's Alpha	0.967	0.870	0.901	0.918	0.929	0.928	0.931
Composite Reliability (CR)	0.976	0.902	0.927	0.939	0.941	0.939	0.940
AVE	0.911	0.609	0.718	0.754	0.524	0.546	0.531

The criterion value for factor loading coefficient appropriateness is 0.4. The coefficients of the factor loadings related to the research factors in this study are greater than 0.4. We can confirm the research's reliability and convergent validity because the appropriate values for Cronbach's alpha, composite reliability, and AVE are 0.7, 0.7, and 0.5, respectively, and all of the criteria in the measurement of factor loadings have appropriate values. Divergent validity is the third criterion for assessing the fit of measurement models, and it addresses a number of issues.

As shown in Table (3), the AVE of each factor is greater than the correlation value of two factors in marked cells with dark colors. As a result, using the Fornell-Larcker criterion, we confirm the research's divergent validity.

A new index called the Heterotrait-Monotrait Ratio, or HTMT has been introduced to assess divergent validity. The acceptable range for the HTMT criterion is 0.85 to 0.9. If this criterion is less than 0.9, divergent validity is acceptable (Henseler et al., 2015).

Table 4. Review of HTMT Criterion Matrix

Variable	Met. I.	Cog. I.	Mot. I.	Beh. I.	HC	SC	RC
Metacognitive Intelligence	-						
Cognitive Intelligence	0.492	-					
Motivational Intelligence	0.664	0.548	-				
Behavioral Intelligence	0.561	0.348	0.745	-			
Human Capital (HC)	0.276	0.446	0.341	0.129	-		
Structural Capital (SC)	0.329	0.512	0.316	0.142	0.789	-	
Relational Capital (RC)	0.416	0.557	0.368	0.170	0.694	0.769	-

The HTMT criterion for all pairs of variables is less than 0.9, according to Table (4). The three cross-loading Table methods, the Fornell-Larcker criterion, and the HTMT criteria confirm the research model's validity.

After examining the fit of measurement models, it is time to fit the research structural model. Unlike the measurement model, the structural model is concerned with hidden factors and their relationships rather than questions (manifest variables). The first and most basic of these criteria is the t-value, which is used to assess the fit of the research model.

The t-value is an important criterion for measuring the relationship between model factors. If the value exceeds 1.96, it indicates that the relationship between the factors is correct and the research hypotheses are confirmed at the 5% error level. It should be noted that the numbers only show the accuracy of the relationship; they cannot measure the intensity of the relationship between the factors.

Table 5. Investigating Relationships within the Structural Model

Relationship			Standard Coefficients	t-value	p-value
Metacognitive I.	→	CQ	0.825	40.528	0.000
Cognitive I.	→	CQ	0.707	19.469	0.000
Motivational I.	→	CQ	0.884	59.870	0.000
Behavioral I.	→	CQ	0.788	32.610	0.000
IC	→	HC	0.878	55.564	0.000
IC	→	SC	0.913	94.176	0.000
IC	→	RC	0.884	56.302	0.000
CQ	→	IC	0.333	4.961	0.000

*Note: CQ refers to Cultural Quotient, or CI.

According to the contents of Table (5), there is a significant relationship between the variables because the T-value for these relationships is greater than 1.96 (an indication of the correctness of the relationship between the factors and as a result of confirming the research hypotheses at the 5% error level).

In a study, the R^2 coefficient is related to the model's endogenous (dependent) hidden factors. R^2 is a measure that shows the impact of an exogenous factor on an endogenous factor, and values of 0.19, 0.33, and 0.67 are considered weak, medium, and strong results, respectively. The R^2 value for exogenous or independent factors is zero.

The validity index of redundancy is used to assess the model's validity. The redundancy index, also known as Stone-Geyser Q^2, assesses the structural model's quality for each endogenous factor while accounting for the measurement model. Suppose the values of these indicators become zero or less than zero for a dependent factor. In that case, it indicates that the relationships between the model's other factors and that dependent factor are not well explained, and the model must be modified as a result. These criteria determine the model's predictive power, and values of this index for one of the endogenous factors of 0.02, 0.15, and 0.35 indicate weak, moderate, and strong predictive power, respectively.

Table 6. Review of R^2, Q^2 and F^2 Criterions

Variable	R^2	Q^2	F^2
Metacognitive Intelligence	0.681	0.581	2.135
Cognitive Intelligence	0.499	0.274	0.997
Motivational Intelligence	0.782	0.526	3.581
Behavioral Intelligence	0.620	0.436	1.633
Human Capital (HC)	0.771	0.363	3.372
Structural Capital (SC)	0.833	0.414	4.992
Relational Capital (RC)	0.782	0.038	3.594
Intellectual Capital (IC)	0.279	0.209	0.162

According to the Table contents, the R2 criterion for most dependent variables is strong, and the Q^2 criterion for dependent variables is strong. The Cohen's F^2 criterion determines the strength of the relationship between the model's constructs. The R^2 index measures effect size and analyses the relationship between the constructs. The values 0.02, 0.15, and 0.35 represent one structure's small, medium, and large impact on another. The F^2 criterion is strong for the majority of variables, according to the contents of Table (6).

Table 7. Test Results of the Research Hypotheses

Hypotheses			Standard Coefficients	t	p	Results
H1: CQ	→	IC	0.231	3.431	0.000	Confirmed
H2: Metacognitive I.	→	IC	0.247	3.568	0.000	Confirmed
H3: Cognitive I.	→	IC	0.264	3.753	0.000	Confirmed
H4: Motivational I.	→	IC	0.226	2.964	0.000	Confirmed
H5: Behavioral I.	→	IC	0.283	3.869	0.000	Confirmed
H6: IC	→	HC	0.878	55.564	0.000	Confirmed
H7: IC	→	SC	0.913	94.176	0.000	Confirmed
H8: IC	→	RC	0.884	56.302	0.000	Confirmed

Measurement and structural models are included in the overall model. The GOF criterion is related to the structural models' overall part. This means that with this criterion, the researcher can control the fit of the overall model after checking the fit of the measurement model and the structural model of this research (Tenenhaus et al., 2004). Tenenhaus et al. (2004), taking the three values of 0.01, 0.25, and 0.36, introduced as weak, medium, and strong values for GOF, and obtaining a value of 0.656 for GOF demonstrates the model's appropriate fit. In general, based on the steps taken to confirm the measurement model and validity and calculations, followed by the test of the relationships between the variables, it should be stated that the model presented by this research is confirmed, and we can now examine the research hypothesis. According to Table (7), all research hypotheses were confirmed. However, the findings were consistent with those of international studies conducted by Tharapos and O'Connell (2023), Kistyanto et al. (2022), and Anik et al. (2021) in terms of the fact that metacognitive, cognitive, motivational, and behavioral aspects of auditors' CI can improve intellectual capital's dimensions of HC, SC, and RC. The framework describes an approach that all audit firms can use to enhance their intangible resources and endorse the capacity of their auditors, on which a profitable interaction with the external environment is based. The model outlines explanations that motivate HC to achieve the audit firms' goal, identifying the motivations, activities, and processes that allow for effective management of strategic IC. Additionally, audit firms, interpreted as CI systems, have potentially a pivotal role in their regions' social and economic development because they are a critical "asset" of the region. Therefore, the conceptual framework developed allows the analysis of the impact of managing IC according to an individual perspective (audit firm level) and a cultural perspective (society and regional level). According to this model, auditors use their intuition to confirm something achieved previously in real-life cultural judgments and, ultimately, to describe their cultural judgments, values, and behaviors. According to research in this field, the components of CI that are related to others are also positively related to IC. According to the findings of this study, CI is positively and significantly related to all aspects of IC, which is consistent with the findings of other studies. Even though HC, SC, and CC are beyond the fulfillment of economic and legal obligations, and individuals do not consider profit maximization when implementing these types of capitals, it is necessary to observe these capitals to prevent social and economic damages, and according to these findings, cultural auditors place a higher value on IC in all aspects. As a result of the findings of this study, it is suggested that to evaluate and improve the IC of organizations, regulatory bodies, and decision-making authorities, consider cultural principles and standards more than ever before and consider CI as a factor affecting adherence to IC. This paper's main contribution to the IC literature is to provide a new practical framework whereby IC in the evolving audit firm is created and managed. The underlying assumption behind the framework is to consider the audit firm as a CI system in which the tangible and intellectual assets are coordinated towards the achievement of strategic goals. An application of the framework is provided to the emerging model of the audit firm, the traditional missions of which – teaching and research – are being broadened to include

new mission activities that facilitate audit firms' engagement with society and regional development.

Applying the framework in practice adds to building IC knowledge by completing the cycle of developing normative frameworks and testing their validity in real work settings. The need for audit firms to have greater involvement with their wider community and the general concern to ensure the informational transparency of these institutions makes it advisable to present information on IC management. General methods for evaluating intangibles within audit firms are justified on the one hand in the political and managerial challenges that audit firms have to manage and disclose information to auditors and on the other hand by the consideration that national and supranational organizations recognize the central role of audit firms in the contemporary knowledge-based society. Below are some reasons why audit firms strategically manage IC: 1) Audit firms produce knowledge through scientific and technical research, teaching or entrepreneurial activities (technology transfer, licensing, etc.). Audit firms' inputs and outputs are largely intangible assets. 2) The greater autonomy of audit firms regarding their organization, management and budget distribution requires greater social accountability to facilitate and satisfy the information needs of internal and external auditors. However, IC approaches need to be reinvented to facilitate a more balanced approach to management, measurement, and reporting that contributes to the strategic management of audit firms. The focus should be on developing IC theory in practice and effective IC management through praxis to provide a better view of the process of developing IC and the impact of IC in action. It is possible to effectively implement IC practices without necessarily needing concrete IC measures because organizational measurement needs continually evolve depending on factors such as the characteristics of individual organizations, changing internal and external political, social and economic environments, and evolving business plans and strategies". The review of theoretical approaches and previous experience in IC management in audit firms suggested a set of requirements for defining and measuring IC in audit firms and provided the necessary criteria and methods for building an initial normative integrated framework to manage IC in audit firms. This is distinctly different from a research approach, which seeks to develop measurement approaches concentrating on measuring IC performance in current practice. Indeed, the approach here is a model that aims to shape praxis and performance rather than measure performance outcomes. The CI approach is adopted to design the new framework, starting from the assumption that the audit firm is a CI system.

5. Discussion and conclusion

The current study examined the relationship between CI and IC dimensions using Bontis' proposed model among all auditors working in auditing firms and audit organizations who are members of the Society of Certified Public Accountants. As previously stated, IC is the ability of intangible resources to create and maintain a competitive advantage, and the influence of CI factors on IC dimensions is undeniable. The research is exploratory and the framework offers opportunities for refinement. A new perspective for managing IC in audit firms adopting the CI approach is developed. Contribution to the ecosystem of IC research is highlighted, expanding the concept of IC value creation beyond the audit firm into wider society. The framework can be used to manage IC strategically in all the systems interpreted as CI systems in which the role of IC creation from multiple actors is relevant. This makes it possible to understand how IC helps create value for society and the region in which the audit firm operates. The paper's originality brings together issues usually dealt with within the literature in separate domains, such as IC management and CI perspective. CI is an unexplored field in audit firms' IC management. The CI approach provides a

novel contribution to managing IC and is intended to inspire future research. In this regard, previous research findings demonstrated that CI could lead an organization to IC, and auditors' high cultural values reflect their high IC. CI is a variable that helps to explain cultural reasoning. The creation and management of IC is thus an operational priority to evaluate the alignment between the strategic orientation and the performance within the audit firms contributing to social engagement and regional development.

However, given the impact of CI on judgments and decision-making and the fact that cultural factors influence the prominence of CI, this theory should be tested again to determine which components are most important in Iran and are used in judgments. Many organizations have found that paying attention to physical and financial resources cannot guarantee survival in recent years, as the current economic paradigm has shifted from a machine-oriented industrial economy to a mind-oriented knowledge economy. Nowadays, the concurrent use of physical and financial capital, IC and human resources aided by CI can create a sustainable competitive advantage and even provide reasons for the auditing profession's survival. IC formation and evolution due to improved CI are critical to the auditing profession's effectiveness and efficiency. In general, auditors acquire the stages of socialization and entry into society through their experiences in the profession's formal and informal educational systems (Hussami et al., 2011). As a result, in many cases, society's expectations of auditors are linked to the development of culture and the expansion of their social capital. CI and its various components can have an impact on IC. These factors can not only improve auditing performance but also play an important role in the auditing profession's social, economic, and even political development (such as improving the status and dignity of accountants and auditors in society and playing an active role in the accounting and auditing profession involving the members of the profession more effectively in the macro-national decision-making by the politicians).

This study examined the impact of auditors' CI on IC. The findings of the first hypothesis test revealed that CI and its components (metacognitive, cognitive, motivational, and behavioral) are among the factors influencing auditors' IC in their judgment and decision-making from a cultural perspective. Auditing is reassuring for shareholders and other financial auditing and reporting users. In addition to this assurance, professional commitment is an essential feature that can strengthen CI and prevent improper intentions from being avoided during the audit process. This survey shows that concerns decrease when relationships between auditors and society improve and the auditing profession is honest. As a result, auditors' propensity to maintain ethics and professional commitment is enhanced. People who see their future as being aligned with the organization's goals are more committed to adopting the desired characteristics of the organization and are willing to act in the organization's interests while avoiding conflict with the client. Auditors dedicated to their profession strive to adhere to professional standards, principles, and rules and respect professional requirements. As a result, those with a strong professional commitment are more sensitive to cultural issues. The findings of this section of the study are consistent with previous research (Tuan Mansor et al., 2020; Meutia et al., 2018; Taylor and Curtis, 2010). In this regard, relevant auditing managers are suggested to create suitable conditions to improve auditors' professional commitment while providing desirable requirements for establishing friendly relations among auditors and offering efficient and effective incentives. In addition to the applicants' knowledge and expertise, auditing firms and auditing organizations should seriously consider individuals' CI and IC when recruiting auditors, and skilled psychologists should be employed in this regard. Furthermore, ongoing training on the importance of ethics and its positive effects on the IC of the auditing profession should be provided. Furthermore, it is recommended that the Iranian Association of Certified Public Accountants codify guidelines for developing regulations related to reporting non-

cultural behaviors that jeopardize economic health in accordance with the enforcement of the Administrative Health Law, notify audit firms, and consider assessing audit firm quality. The results of the second, third, and fourth hypotheses imply that auditors' IC will have more HC, SC, and RC as they increase. Auditors can be influenced by environmental and psychological factors, which can have a complex impact on disclosure purposes. Auditors typically have a track record of success in the workplace, and gaining positions that others can rely on is critical for them; as a result, they will have more IC. The findings of this hypothesis are consistent with the findings of one study (Winfield, 1994) but do not agree with the findings of another study (Liyanarachchi and Adler, 2011).

Naturally, any research begins with a sketch in the researcher's mind. It is nurtured and identified in its domains, dimensions, and methodology, eventually leading to findings and results through data collection and analysis. As a result, there may be some obstacles and limitations along the way, with the main limitation of this research being the use of the questionnaire, which has inherent limitations. Based on this limitation, respondents may not be cautious when answering questions or their conditions, and moods may change under environmental conditions, causing them to misinterpret the answers and challenging the generalization of the results to the population, which is beyond the researcher's control. Another limitation of this study was the country's lack of research in this field, which limited the researcher to studying the background in Iran and comparing the results with local studies. The main criteria of CI and IC were used in this survey. Other variables, such as the size of the audit firm, can be used in future research. Furthermore, researchers can conduct the same research on the subject under consideration in this study at the level of auditors of governmental organizations (Court of Audit).

In recent decades, researchers have paid close attention to the concept of IC, and paying attention to social interests has become more important than economic and legal rules. This concept is now one of the most important issues in the academic and business worlds. Auditors consider it in their decisions, whether voluntarily or compulsorily because implementing IC provides several obvious and hidden benefits to the auditing profession and society. By raising awareness in this area, identifying the factors influencing auditors' perceptions of IC can thus effectively improve organizations' sense of responsibility and accountability. CI has a positive relationship with HC and the structural and relational aspects of IC, according to the findings of this study. Because managers and employees choose to observe different aspects of IC, cultural programs and strengthening cultural attitudes reinforce an organization's cultural culture and draw auditors' attention to perceiving and observing IC. This eventually leads auditors to combine society's expectations with the organization's human, structural, and relational goals in their decisions to ensure survival and long-term benefits.

IC examines the main dynamics influencing economic competition in knowledge economics from various perspectives. It must be a driving force in the auditing process, with the pattern of success being the development of IC, including administrative management skills. Nowadays, the transition from negative behavior in human resource management to positive attitudes among auditors is unavoidable, manifested in the creation of favorable conditions for knowledge acquisition, skill improvement, and universal development of working power. HC investments are long-term investments that should not be overlooked by managers who are focused on short-term objectives. It is critical to create an environment in the economic and political systems that will encourage organizations to participate in the creation of HC as a basic component of IC, thereby increasing motivation to invest in it. Organizations that use their ability to find and develop HC to gain a competitive advantage to the greatest extent possible will be highlighted shortly. The beginning of the third millennium heralds a period in which the nature of organizations shifts.

Auditors must deal with new methods while utilizing existing resources. A new epoch brings with it new hopes as well as hidden dangers. One of them is a careless attitude toward recognizing an unusually rapid development. Society, customers, technology, and competition are all constantly changing. If an organization wants to succeed, it must change; otherwise, the key competence can easily become the key inconvenience, resulting in a setback.

The new millennium is known for the constantly accelerating changes and economics based on IC, which are critical to underpin and efficiently manage. The importance of knowledge cannot be overstated. It is taken into account at the global, national, and organizational levels. IC Management (ICM) is a contemporary challenge. Searching for possibilities and methods of quantifying the return on investment in human resource development and an effort in strategic management in the form of IC Management (ICM) should be essential components. The findings of this study show that CI, as one of the ethics mechanisms, can help auditors build IC. As science and technology advance, communities become more sophisticated and specialized. Organizations are no exception as societal institutions.

Committed, motivated, and skilled HC is created in today's highly competitive world simply by considering individual needs and training and educating human resources. Ethics, transparency, and CI against wrongdoing are more important than ever in such circumstances. The auditors' professional commitment reflects their adherence to rules and regulations. The code of professional conduct for auditors, which encourages them to follow professional ethics, is possibly the most important rule of the auditing profession. CI is a cultural component in the public interest because it can prevent potential harm (illegal, immoral, and illegitimate activities) to external and internal stakeholders. As a result, auditors' commitment to their profession and its requirements, including the code of professional conduct, is likely to improve their CI. Auditors and those who use auditing services must be committed to their profession. Members of this profession must be expected to go above and beyond society's rules and regulations while adhering to cultural and professional principles. This research undoubtedly helps to understand and recognize auditors' attitudes in both the private and public sectors. These findings could be used to develop cultural principles of the profession and policy in attracting auditors, particularly those certified by the Exchange and Securities Organization and the Iranian Association of Certified Public Accountants.

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RESEARCH ARTICLE

How is the Iranian Stock Market Affected by Geopolitical Risk and Economic Policy Uncertainty in China, the US, and Globally?

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Abstract

In the contemporary global economy, the interconnectedness of national markets has become increasingly pronounced. Over the past decade, Iran has experienced an annual average import of approximately $40 billion and exports of $38 billion, highlighting emerging cross-border economic linkages. These international connections mean that domestic factors within Iran's markets are now heavily influenced by external forces. This research investigates the impact of two types of uncertainty—geopolitical risk (GPR) and economic policy uncertainty (EPU)—originating from global, Chinese, and United States sources on the returns and volatility of the Iranian stock exchange. Monthly data from November 2008 to March 2024 were analyzed using a Generalized Additive Model (GAM). The results demonstrate that EPU from global and Chinese sources significantly nonlinearly affects the returns and volatility of the Iranian stock market. In contrast, EPU from the United States only impacts stock market volatility. GPR from China and globally has a direct linear effect on both returns and volatility. The combined effects of EPU and GPR from China and the US also significantly influence returns and volatility, while the simultaneous global effects only impact the returns of the Iranian stock exchange. The findings in the field of GPR indicate that when GPR occurs, investors in the Iranian stock market consider it a safe asset, and the occurrence of GPR serves as an incentive to enter the capital market in Iran. Conversely, the findings regarding EPU suggest that when investors perceive EPU from China, it leads to specific economic effects, prompting them to alter their portfolios. However, the recognition of EPU from the US and global sources is less pronounced among investors, leading them to prefer not to take action. These findings hold important implications for investors and stakeholders in the Iranian financial markets, providing insights that can inform investment strategies and policy decisions.

Keywords:
Economic Policy Uncertainty,
Geopolitical Risk,
Generalized Additive Model,
Stock Market Return

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1. Introduction

The past three decades have seen increased financial and real globalization in developed and developing economies worldwide. In financial markets, global integration is strengthened through the formation of free trade areas or currency unions, allowing economic shocks in certain countries or regions to be transmitted to the rest of the world. In a situation where economies are increasingly integrated into the global economy, even if an economy chooses not to adopt a globalization policy, it will still be affected by the global economy. It brings limited economies; today, the global economy is interconnected through trade and financial flows. Uncertainty in a leading economy, such as China and the United States, is not confined within its borders and can spread to the rest of the world. For this reason, a recently growing body of literature has examined international uncertainty spillovers (Berger et al., 2017; Carrière-Swallow and Céspedes, 2013; Gabauer and Gupta, 2018; Gupta et al., 2016; Kamber et al., 2016; Trung, 2019; Yin and Han, 2014) .In the meantime, various studies have examined the relationship between uncertainty in a large and global economy such as the United States and China on stock returns in foreign markets (Christou et al., 2017; Hu et al., 2018; Ko and Lee, 2015; Phan et al., 2018) . In these studies, the uncertainties of the origin countries are used to predict the market returns of other countries. The results mainly show that these spillovers have a negative effect on the stock returns of the destination country. However, both the theoretical and empirical literature ignore that relationships may change when political and economic relationships are complex. There are various types of risk and uncertainty in both domestic and foreign countries, and investors include stocks from other countries in their asset portfolio to optimise portfolio management.

The literature shows that the choice of a foreign country is based on the level of risk and uncertainty in that country; the total of this portfolio management of domestic and foreign country stocks has led to the expansion of international capital flows in the world stock markets. International portfolio diversification and foreign direct investment are among the main drivers of stock market integration(Andrikopoulos et al., 2023; Babaei et al., 2023) .With the increase of the conflict between the gears of the international economy and the globalization of the economy, the influence of the linkage of the global financial markets has increased. While there has been a significant increase in the correlation between stocks around the world (Mensi et al., 2023), the spillover between uncertainties and Different financial markets has also increased in different countries (Jiang and Ye, 2022), any GPR and uncertainty can be immediately received by international investors and automatically lead to structural changes in the price and volatility of assets (Belcaid and El Ghini, 2019), uncertainties are the main obstacle to the growth of financial markets (Uddin et al., 2021) and cause the stagnation in financial markets to intensify (Tsai, 2017).

Literature also shows that uncertainty has adverse effects on financial activities and company value (Boutchkova et al., 2012; Brogaard and Detzel, 2015; Pastor and Veronesi, 2012; Pástor and Veronesi, 2013). Although the origin of theoretical literature entering the field of uncertainty and financial market is relatively old and it can be seen Markowits (1952), Roy (1952), and Tobin (1958) as the pioneers of this field, considering that nowadays, unfortunately, "black swan events" which are the source of increasing uncertainty in the global economy, occur frequently and affect economic activities and financial markets (Dong et al., 2023; Wei et al., 2022) ،the attention to uncertainty and its criteria, as well as the impact on economic activities and financial markets, has again been the focus of researchers (Baker et al., 2016; Basu and Bundick, 2017; Bekaert et al., 2013; Bloom, 2009; Jurado et al., 2015; Lahiri and Sheng, 2010; Leduc and Liu, 2016; Orlik and

Veldkamp, 2014).

There are various indices to show uncertainty; in the existing literature, mainly two indices are used to show uncertainties: a) geopolitical risk index (GPR) introduced by Caldara and Iacoviello (2022), b) economic policy uncertainty index (EPU) by Baker et al. (2016) has been introduced.

GPR is defined as:" the risk associated with wars, terrorist acts, and tensions between states that affect the normal course of domestic politics and international relations "(Caldara and Iacoviello, 2022), and events such as the US presidential election, the US-China trade war, Brexit, the recent war in Ukraine, nuclear threats and recent tensions in the Middle East all fall under the heading of GPR (Fiorillo et al., 2023).

The impact of geopolitical uncertainty on oil (Bouoiyour et al., 2019), precious metals (Baur and Smales, 2020), commodity market (Ramiah et al., 2019), and cryptocurrencies (Bouri and Gupta, 2021) has been investigated. Still, the literature Related to geopolitical uncertainty and the stock market, especially in the GPR influence of other countries, has been relatively neglected.

The EPU is defined as uncertainty regarding financial, regulatory or monetary policy (Brogaard and Detzel, 2015) and refers to the contributions of policymakers to create uncertainty (Baker et al., 2016). This EPU reflects the development of pessimistic expectations(Arouri et al., 2016; Guo et al., 2018) and refers to a variety of macroeconomic policy uncertainties, including uncertainty of policy expectations, uncertainty of policy implementation, and the possibility of changing the position of government policies, particularly at the financial, monetary and regulatory levels (Gulen and Ion, 2016; Le and Zak, 2006), EPU refers to the inability of market participants to predict policy and economic decisions made by governments (Lean et al., 2024) and we define and explain EPU as follows: a phenomenon that has the nature of information asymmetry and refers to information gaps between politicians and other economic factors, which are largely concerned with monetary and fiscal policy.

The basis of the distinction between EPU and GPR lies in the fact that EPU depicts uncertainty about the real economy. At the same time, GPR represents the risk components related to war and war situations; GPR is not linked to the business cycle and has no economic basis (Fiorillo et al., 2023). The argument for the necessity of using EPU and GPR and their effects on the stock market is presented by Kannadhasan and Das (2020) with emphasis on data extraction methodology: The EPU index is estimated using a text mining method from the outputs of 10 leading newspapers using important terms of economic events, such as "monetary policy, fiscal policy, taxation", etc., but the GPR is estimated using the outputs of 11 newspapers. Information related to geopolitical tensions such as "terrorism", "military conflicts", "political tensions", "communal disharmony" and other cases are used, and there are fundamental differences in the estimation and nature of these indicators. Dong et al. (2023) also state that the correlation between GPR and EPU indices is very small and proves that these two indices show risk and uncertainty from different perspectives; the behavioral decisions of investors are likely to be different when faced with different risks. The existing empirical literature on the impact of GPR and EPU uncertainty on the financial market is severely limited.

This study has six contributions: 1) Examines the impact of GPR and EPU with three sources in China, the US and the global[1] on stock market volatility; 2- The case study is Iran's financial market. 3 As a robustness check in addition to stock market volatility, the effects on stock market returns are also examined; 4- Linear or nonlinear effects are examined and tested, 5- Impact of

1 . A total of six uncertainties are examined, global GPR, U.S. GPR, GPR, GLOBAL EPU, US EPU and China EPU

coefficients, with attention to different values of independent variables (uncertainties), is separately investigated, 6. The simultaneous relationship of two uncertainties[1] on the stock market is investigated.

The other parts of the paper are organized as follows: In Part 2, the literature related to the subject is discussed; in Part 3 the Generalized additive model (GAM) is presented, and while introducing the data reference, a brief explanation is provided about them, in Part 4, model estimation and results are presented, for this purpose a table of results and a significant review are presented, followed by smooth function monovariate diagrams (Represents beta changes per change in the values of the independent variable) and bivariate variables (indicating changes in dependent variable for simultaneous changes in two independent variables) are presented and in Part 5, while summarizing and presenting the results briefly, suggestions are presented.

2. Literature and theoretical foundations

2.1 Risk spillover channels originating from foreign countries

Today, international economics has become more interrelated due to the expansion of global trade and the increase in foreign investment, resulting in a significant increase in the correlation between stocks around the world (Mensi et al., 2023) and the spread of economies to each other can be studied through the risk and uncertainty of one country to another(Liang et al., 2020). The current state of the world, recent economic and political events, such as the ongoing U.S.-China trade conflict, and general emergencies, such as the COVID-19 outbreak, have increased uncertainty, market volatility following the Russian president's decision to invade Ukraine, Britain's vote to leave the European Union, and the U.S. presidential election in 2016 and 2020, there are examples of how political uncertainty in one country can affect companies and stock markets in other countries (Fulgence et al., 2023) and turn uncertainties into a topic of interest for policymakers, investors and academics, as it is argued that uncertainties are the cause of investment risks(Amore and Corina, 2021; Cao et al., 2019)

Among countries, the role of the United States economy has a special place; the United States is the largest economy on the planet, has about one-fifth of global production, energy demand, foreign direct investment (FDI), and has one-tenth of global trade and one-third of Stock market value (Balli et al., 2021). Since the United States has the world's largest stock market, early tremors in the U.S. economy and financial markets are not limited to the U.S. but also spread to other countries, the financial crisis of 2008 has shown that the US stock market crash can be moved to other countries at an astonishing rate, eventually leading to a global crisis (Su et al., 2019) and stock markets can receive the spillover effects of uncertainty from other countries (Belcaid and El Ghini, 2019; Boako and Alagidede, 2018), on the other hand, the financial investment of the United States in other countries has increased, and this issue has caused the transfer of risk to the financial markets of the world countries, therefore, the uncertainty is transferred to the financial markets (Balli et al., 2021) also, the United States always tries to attract many international investors, as a result, large international investors invest in the stock market of the United States and their own country, so the uncertainty related to the United States in addition to having an effect on The stock market of this country is also transferred to the country of origin through foreign investors (Jiang et al., 2023) in fact, the risk and uncertainty for a company does not depend solely on the location of its production and location, but also on the location where the company is located (Ardelean et al., 2017). Jiang et al. (2023) state the mechanism of this transition as follows: US uncertainty affects international stock returns through the cash flow channel and the discount rate.

1 . China EPU and GPR, EPU & GPR World, U.S. EPU & GPR

Examining the customs data of the Islamic Republic of Iran shows that, on average, in the last 10 years, Iran has annually imported about 40 thousand million dollars and exported 38 thousand million dollars. China's share has been about 26% of imports and 23% of exports. Therefore, China's uncertainties can spill over into Iran's conditions. Considering the significant proportion of China in Iran's exports and imports, China's supply and demand affect Iran's economy, as Miller and Temurshoev (2017) consider cross-border supply and demand as a driver of production in countries. Therefore, Iran is sensitive to the uncertainty shocks of China, and this sensitivity also affects the stock market.

According to the existing literature, uncertainty with external origin significantly impacts stocks.

2.2 GPR and the stock market

2.2.1 Channels of influence of GPR on the stock market

Theoretically, the communication channels between GPR and the stock market can be presented in different categories.

GPR and Productivity Change: Geopolitical uncertainty hampers the proper development of financial markets, leading to inefficiencies (Ding et al., 2022), which can impact the stock market.

GPR and Production Reduction: Geopolitical uncertainty often correlates with temporary halts in production. For instance, Bloom (2009) notes that events like the Cuban Missile Crisis, JFK's assassination, OPEC oil price shocks, and the 9/11 terrorist attacks increase uncertainty and cause firms to hold back on investments and hiring in the short term. Saint Akadiri et al. (2020) demonstrate that rising geopolitical uncertainty significantly hampers short-term and long-term economic growth, reducing production flow's influence on the stock market.

GPR and Corporate Investment: GPR plays a crucial role in investment decisions. Higher GPR increases the risk of investing in financial markets, prompting investors to exit and seek safer financial instruments (Zhang et al., 2023). GPR affects corporate investment in two ways: first, it reduces overall investment (Wang et al., 2019), and second, it delays the decision-making process of market participants, causing delays in companies' investment activities (Salisu et al., 2022). Thus, GPR can have an impact on the stock market.

GPR and Innovation (Technological Improvement): GPR negatively affects R&D investment (Pan, 2019), but it can stimulate innovation in certain companies, especially state-owned or government-subsidized firms (Jia et al., 2022). Yu and Wang (2023) examine the impact of geopolitical uncertainty and foreign direct investment (FDI) in 41 countries from 2003 to 2020, revealing that geopolitical uncertainty can hinder FDI inflows and impede innovation spillover. The relationship between FDI and stock returns is also positive and significant (Haq, 2019) ،Additionally, an increase in GPR can reduce global trade and investment, resulting in a decrease in the globalization index, Consequently, while raising financing costs for companies, GPR inhibits technology transfer, weakens innovation, and affects company stocks.

GPR and Energy Prices: Recent years have witnessed significant volatility in global oil prices due to natural disasters, economic crises, geopolitical conflicts, and terrorist attacks (Sheng et al., 2020; Silvennoinen and Thorp, 2013). Understanding the key determinants of oil prices is crucial for decision-makers in investment, consumption, production, risk management, and policy formulation (Xu et al., 2021). Geopolitical tensions, including civil wars, terrorism, and armed conflicts, have been closely associated with oil price dynamics (Hu et al., 2020). Su et al. (2021) investigate the relationship between oil prices and geopolitical uncertainty, finding that an increase in geopolitical uncertainty (e.g., war) leads to higher oil prices. Still, decreasing geopolitical uncertainty does not necessarily result in lower oil prices. They further suggest that the price of oil

itself can contribute to an increase in geopolitical uncertainty, highlighting its political characteristics. However, different studies present varied results. While some find a positive and significant impact of geopolitical uncertainty on oil prices, especially before 2000 (Noguera-Santaella, 2016), others show insignificant effects(Bouoiyour et al., 2019; Monge et al., 2017) or limited impact due to OPEC's ability to adjust production capacity and oil reserves(Selmi et al., 2020) .Overall, GPR's influence on oil prices can affect production and subsequently impact the stock market, considering oil's significance as a production input**.**

2.2.2 Studies in the field of GPR and stock market

The literature on the relationship between GPR and the stock market can be divided into three categories: the effect of GPR on stock market returns, the effect of GPR on stock market volatility, and the effect of GPR on stock market returns and volatility.

The connection between Geopolitical Risk (GPR) and stock market return: Arfaoui and Naoui (2022) found that terrorist attacks rapidly reduce stock market returns in the UK and France. Balcilar et al. (2018) examined the impact of GPR on returns and volatility in BRICS stock markets and observed that these markets do not uniformly react to GPRs. Instead, GPRs tend to affect stock market volatility rather than returns. Rawat and Arif (2018) investigated the effects of geopolitical shocks on stock market returns in BRIC economies and discovered that the impact of GPR on stock returns varies across countries, with Brazilian and Russian funds showing more sensitivity compared to Indian and Chinese funds. However, some studies argue against a consistent negative impact of GPR on returns and stock prices. For example, Ramiah et al. (2010) suggest that the perceived cost of terrorist attacks may not always be accurately reflected in stock market reactions. Cam (2008) proposes that in conditions of heightened GPRs, sectors such as defense, water, and communication may experience increased demand, potentially leading to higher stock prices in those sectors. Ma et al. (2022) investigated the effect of GPR on stock return prediction and found that the Geopolitical Threats Index (GPRHT) can help forecast stock returns.

The association between GPR and stock market volatility: Salisu et al. (2022) examined the relationship between GPR and stock market volatility in emerging economies, revealing that GPRs increase stock market volatility. They also noted that the GPR index related to actionable threats has a stronger impact than the GPR index related to affective threats. Bouras et al. (2019) studied the role of individual country and global GPRs on stock market returns and volatility in 18 emerging economies, finding that country-specific GPRs affect neither returns nor volatility significantly. However, when considering a broad measure of global GPR, the effect on volatility is economically and statistically robust, whereas the effect on returns is not significant. Ndako et al. (2021) investigated the impact of GPR on the volatility of Islamic stock returns in Indonesia and Malaysia, discovering that GPR increases volatility in both countries, with a greater impact observed in Indonesia. Additional analysis in their study demonstrates that incorporating GPR data improves the prediction of volatility in Islamic stock returns. Chiang (2021) asserts that GPRs cause significant volatility in the global economy, particularly in financial markets, making them crucial factors for investment decisions and portfolio selection to safeguard asset values. Zhang et al. (2023) examined the relationship between GPR and global stock market volatility, finding a positive and significant effect of GPR on stock market volatility. They also observed that the impact of GPR on stock market volatility is higher in emerging economies, crude oil exporters, and peaceful countries.

The relationship between GPR and stock market returns and volatility: Apergis et al. (2018)

discovered that GPR can predict the volatility of 50% of these companies but cannot predict their returns. Based on the existing empirical literature, there appears to be a significant relationship between GPR and stock market returns and volatility.

2.3 EPU and the Stock Market

The relationship between EPU and the stock market can be divided into two categories: from the perspective of companies and from the perspective of investors.

From the point of view of companies: according to Bloom (2009), a sudden increase in economic uncertainty disrupts the prospects of business and household consumption and leads to a decrease in future cash flows compared to the level predicted by companies, and in turn, causes a decrease in company performance and reducing stock returns.

From the point of view of investors, the increase in uncertainties makes investors move the decision-making to the future period; on the other hand, according to the argument of Bali et al. (2017), in the face of a sudden increase in economic uncertainty, investors turn to assets that they believe will increase their returns during times of economic uncertainty to protect against asset declines. This suggests that investors are willing to hold stocks with higher covariance with economic uncertainty. In doing so, they are willing to pay higher prices and accept lower returns for stocks with greater uncertainty. These changes in assets cause changes in asset returns.

Mei et al. (2018) studied the impact of the US Economic Policy Uncertainty (EPU) on the European stock market. The findings indicate that the US EPU can influence the prediction of European stocks. However, the European EPU index itself does not significantly enhance forecast accuracy. Su et al. (2019) employed a bivariate GARCH-MIDAS model to examine the influence of US EPU on stock market volatility in six industrialized countries (Germany, France, the UK, Japan, Italy, and Canada) and three emerging countries (China, India, and Russia). They found a positive correlation between US EPU and stock market volatility in these countries. Dakhlaoui and Aloui (2016) analyzed the interaction between US economic policy uncertainty and BRIC stock markets. Their results revealed a time-varying correlation between US economic uncertainty and stock market volatility, which fluctuates during periods of global economic instability. Christou et al. (2017) employed a panel VAR model for Australia, Canada, China, Japan, South Korea, and the United States from January 1998 to December 2014. They discovered that an increase in US EPU negatively impacts stock returns in all countries except Australia. Additionally, each country's EPU has a negative effect on its own stock returns. Tsai (2017) investigated the effect of EPU in four countries or regions (China, Japan, Europe, and the United States) on the stock returns of 22 markets worldwide. The results indicate that China's EPU has the most significant influence and exhibits contagion risk in various regional markets, except for Europe. The effect of US EPU is weaker than that of China, with Japan's EPU only affecting contagion risk in emerging markets. The European financial market is not affected by EPU.

2.4 EPU and GPR on the stock market

Kannadhasan and Das (2020) conducted a study to examine the influence of economic policy uncertainty (EPU) and geopolitical risk (GPR) shocks on the stock markets of emerging Asian economies using a quantile regression model. The findings indicate that EPU has a consistently negative relationship across all quantiles. At the same time, GPR exhibits a negative relationship in the lower quantiles and a positive relationship in the middle and upper quantiles (with EPU having a stronger impact on reducing asset prices compared to GPR). Furthermore, the negative effect of

EPU is stronger than the negative effect of GPR, and the dependence of stock returns on EPU and GPR exhibits asymmetric behavior. Zhang et al. (2023) explored the impact of global economic uncertainty measures on stock market volatility in China and found that the global economic policy uncertainty index, GPR index, and global economic condition index significantly affect the long-term volatility of China's stock market. Dong et al. (2023) investigated the impact of geopolitical, economic, and climate policy uncertainties (CPU, EPU, GPR, respectively) on the correlation between conventional stock markets and long-term energy stocks, as well as the correlation between conventional bonds and green bonds. They discovered that all three uncertainties lead to changes in the correlation between conventional and energy stocks. Additionally, when EPU and CPU levels are high, green bonds outperform conventional bonds, while the effects of GPR changes influence the superiority of each type of bond. Das et al. (2019) studied the effects of international economic policy uncertainty, GPR, and financial stress on the stock markets of 24 emerging economies using monthly data from January 1997 to May 2018. The results indicate heterogeneity in causality and severity of the shocks, with EPU having a greater impact than GPR and financial stress (FS). Khraiche et al. (2023) examined the impact of GPR on stock market development in a sample of 37 countries from 1975 to 2019. They found that the effects of GPR on stock market development vary across countries, with a stronger negative effect observed in North America and Europe compared to Asia. Additionally, the impact of GPR is greater in economies with higher levels of investment. Based on the existing literature, it is evident that GPR and EPU originating from outside regions such as America, China, and the world have a significant impact on the European stock market.

According to the existing literature, it seems that GPR and EPU originating from outside the region (United States, China and the world) significantly impact the Iranian stock market.

3. Methodology and model

3.1 Methodology

In classical econometric models, the relationship between independent and dependent variables is mainly considered to be linear, an assumption that may not always be maintained or may change in certain circumstances. One of the models that assume the linearity of the relationship as The basic assumption is not considered the Generalized additive model (GAM) (Wood, 2006a)

The advantage of this model over other nonlinear models is in not determining the default for the relationship between dependent and independent variables, and the model itself provides the form of the relationship function; another unique advantage of the GAM model is to examine the interaction of several variables. It is independent and simultaneous.

In GAM, the relationship curve between independent and dependent variables (smoothing function (f)) is estimated through splines(Wood et al., 2015)

To specify the location of notes and prevent excessive smoothing of splines in GAM, a roughness penalty term is added to the error So that the smoother the smoothing function is, the compensation term decreases and vice versa (Wood and Augustin, 2002)

The family of GAM models was introduced in 1987 by Hastie and Tibshirani (1987); in 1995, Hastie and Tibshirani (1995) pointed out the applications of GAM models in medical research, including the Cox model, in an article.

The tensor product is one of the important splines in estimating the multivariate smoothing function. The application of this spline in GAM was first introduced in 2006 by Wood (2006b)**.** This spline is used when the independent variables are not the same and the results do not change by changing the scale of one variable.

The GAM model is generally defined as follows:

$$g(\pi_i) = \beta X_i + s_1(x_{i,1}) + s_2(x_{i,2}) + ti_3(x_{i,3}, x_{i,4}) + \cdots$$

Where function f is called the smooth function.

Smooth function is generally obtained as follows:

$$s(x) = \sum_{j=1}^{k} \beta_j \times b_j(x)$$

In the above relation, $\beta_j$is a constant and unknown value, b_j is the known basic function.

To control the amount of smoothing, the term roughness penalty (J) is added to the logarithm of likelihood as follows.

$$\boldsymbol{l} = L(\theta|Y) - \frac{1}{2}(\lambda_1 J(s_1) + \lambda_2 J(s_2) + \lambda_3 J(ti_3) + \cdots)$$

The cubic spline to estimate the smoothing function is defined as follows:

$$s_t(t) = \sum_i \delta_i |t - t_i|^3 + b_1 + b_2 t$$

Parameters δ_i،b_1 & b_2 are fixed and uncertain numbers that are estimated by considering the relations $\sum_{\boldsymbol{i}} \delta_i = \sum_{\boldsymbol{i}} \delta_i t_i = 0$

The roughness penalty in this smoothing function is defined as follows.

$$J_t(s_t) = \int \left[\frac{ds_t^2(t)}{dt}\right]^2 dt$$

The smoothing function of two variables $f_{p\&q}(p_i, q_i)$ is estimated with the help of a tensor product spline. Suppose the marginal smoothers are defined as follows:

$$s_p(p) = \sum_{l_1=1}^{L_1} \delta_{l_l} \times b_{l_l}(p)$$

$$s_q(q) = \sum_{l_2=1}^{L_2} \delta_{l_2} \times b_{l_2}(q)$$

The functions b_{l_l} and $b_{l_2}$are certain basic functions. δ_{l_l} and δ_{l_2} are fixed and unknown coefficients. A cubic spline can be considered for edge smoothing.

The joint smoother is defined as follows:

$$ti_{p,q}(p,q) = \sum_{l_1=1}^{L_1} \sum_{l_2=1}^{L_2} \delta_{l_1,l_2} \times b_{l_l}(p) \times b_{l_2}(q)$$

Suppose we define the conditional smoothing function as follows.

$$s_{p|q=y}(x) = \sum_{l_1=1}^{L_1} \delta_{l_l}(y) \times b_{l_l}(p)$$

Then, the roughness penalty of the smoothing function is defined as follows.

$$J(ti_{p,q}) = \lambda_q \times \sum_{p=1}^{L_1} J(s_{q|p}) + \lambda_p \times \sum_{q=1}^{L_2} J(s_{p|q})$$

$\lambda_p$and $\lambda_q$parameters are smoothing control parameters in the p and q direction.

3.2. Model

According to the research literature, the model of this research is suggested as follows:

model1: $TEPIX\_Return_t = s_1(\text{EPU}_{\text{Global}_t}) + s_2(EPU_{China_t}) + s_3(\text{EPU}_{US_t}) + s_4(GPR_t) + s_5(GPR_{CHINA_t}) + s_6(GPR_{US_t}) + ti_{1\&4}(\text{EPU}_{\text{Global}_t}, GPR_t) + ti_{2\&5}(EPU_{China_t}, GPR_{CHINA_t}) + ti_{3\&6}(\text{EPU}_{US_t}, GPR_{US_t}) + \varepsilon_t$

model2: $TEPIX\_Volatility_t = s_1(\text{EPU}_{\text{Global}_t}) + s_2(EPU_{China_t}) + s_3(\text{EPU}_{US_t}) + s_4(GPR_t) + s_5(GPR_{CHINA_t}) + s_6(GPR_{US_t}) + ti_{1\&4}(\text{EPU}_{\text{Global}_t}, GPR_t) + ti_{2\&5}(EPU_{China_t}, GPR_{CHINA_t}) + ti_{3\&6}(\text{EPU}_{US_t}, GPR_{US_t}) + \varepsilon_t$

The data has been used monthly from November 2008 to March 2024, Where t is the time (month), Independent variables are explained in Table 1 and dependent variables in Table 2

Table 1. Independent variables

Variable	explanation	Source	Provider
EPU_Global_	economic policy uncertainty in the global. The EPU Index is a GDP-weighted average of national EPU indices for 21 countries: Australia, Brazil, Canada, Chile, China, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States.	http://www.policyuncertainty.com/gpr.html	(Baker et al., 2016)
EPU_China_	economic policy uncertainty in China. To measure economic policy uncertainty in China, we construct a scaled frequency count of articles about policy-related economic uncertainty in the South China Morning Post (SCMP), Hong Kong's leading English-language newspaper. The method follows our news-based indexes of economic policy uncertainty for the United States and other countries.	http://www.policyuncertainty.com/gpr.html	(Baker et al., 2013)
EPU_US_	economic policy uncertainty in the US. The monthly news-based Economic Policy Uncertainty Index is based on newspaper archives from Access World News's NewsBank service. The NewsBank Access World News database contains the archives of thousands of newspapers and other news sources from across the globe. While NewsBank has a wide range of news sources, from newspapers to magazines to newswire services, we conduct our analysis only utilizing newspaper sources.	http://www.policyuncertainty.com/gpr.html	(Baker et al., 2016)
GPR	GPR in the global. The Caldara and Iacoviello GPR index reflects automated text-search results of the electronic archives of 10 newspapers: Chicago Tribune, the Daily Telegraph, Financial Times, The Globe and Mail, The Guardian, the Los Angeles Times, The New York Times, USA Today, The Wall Street Journal, and The Washington Post. Caldara and Iacoviello calculate the index by counting the number of articles related to adverse geopolitical events in each newspaper for each month (as a share of the total number of news articles)	https://www.matteoiacoviello.com/gpr.htm	(Caldara and Iacoviello, 2022)
GPR_CHINA_	GPR in China	https://www.matteoiacoviello.com/gpr.htm	(Baker et al., 2016)
GPR_US_	GPR in US	https://www.matteoiacoviello.com/gpr.htm	(Baker et al., 2016)

According to Table (1), independent variables are used in this article; the other three independent variables mentioned in the model show the simultaneous effect of two independent variables. Table (2) describes the dependent variables.

Table2. Dependent variables

model	Variable	explanation	Source
1	TEPIX_Return	Monthly returns of the Iranian stock market	www.tsetmc.com
2	TEPIX_Volatility	Monthly volatility of the Iranian stock market	www.tsetmc.com

The lowest value of EPU_CHINA is in M2-2011 and the highest value is in M6-2019. The lowest value of EPU_GLOBAL is in M6-2014 and the highest value is in M5-2020, and finally the lowest value of EPU_USA is in M8-2014 and the highest value is in M5-2020.

The lowest value of GPR corresponds to M7-2021 and the highest value corresponds to M3-2022, the lowest value of GPR_CHINA corresponds to M5-2011 and the highest value corresponds to M3-2022 and finally the lowest value of GPR_USA corresponds to M7-2021 and Most of it is related to M3-2022.

The highest value of TEPIX_RETURN occurred during 2020-M7 and the lowest value was in 2021-M1. The highest value of TEPIX_VOLATILITY was M7-2020 and the lowest value was M6-2015.

According to Table (2) and the explanations provided, a total of 2 models have been fitted; firstly, the uncertainties on the monthly returns of the Iranian stock market are fitted and presented in parts 1-4, then in parts 2-4. The effects on the monthly volatility of the Iranian stock market are presented:

4. Results and robustness

4.1 Descriptive Statistics

Empirical results (The impact of uncertainties on the monthly returns of the Iranian stock market).

In order to familiarize ourselves with the values of the variables, we used descriptive statistics, and the results are presented in Table (3).

Table 3. Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
EPU_CHINA_	300.810	229.860	852.050	59.440	187.930	0.660	2.270
EPU_GLOBAL_	184.080	166.120	431.560	86.350	72.200	0.770	2.910
EPU_US_	159.320	146.940	503.960	63.880	66.350	2.070	9.260
GPR	98.060	90.630	318.950	58.420	29.800	3.150	20.040
GPR_CHINA_	0.650	0.590	2.470	0.210	0.340	1.420	6.860
GPR_USA_	2.220	2.040	6.900	1.250	0.710	2.340	13.120
TEPIX_RETURN	0.030	0.020	0.450	-0.140	0.080	1.780	8.850
TEPIX_VOLATILITY	0.060	0.040	0.450	0.000	0.070	2.910	14.860

Source: research calculations

Descriptive statistics of the research data, including information about the average, median,

minimum, maximum, and standard deviation and skewness of the data, can be seen in Table (3); the above results were extracted from the monthly data review from November 2008 to March 2024. The descriptive statistics analysis shows that the section related to economic policy uncertainty, EPU_CHINA, has values between 59 and 852 and an average value of 300 units. EPU_GLOBAL has values between 86 and 431, with an average of 184. EPU_US ranges from 63 to 503 and usually has an average value of 159.

Also, in the data related to geopolitical uncertainty, GPR fluctuates between 58 and 318, and its average is 98; GPR_CHINA fluctuates between 0.21 and 2.47, and its average is 0.65, and finally, GPR_USA ranges from 1.25 to It fluctuates 6.90 and its average is 2.22.

The data related to the dependent variable shows that TEPIX_RETURN has fluctuated between -0.14 and 0.45, the average monthly return in the period under review was equal to 0.03, and TEPIX_VOLATILITY was between 0 and 0.45 and On average, monthly fluctuations were equal to 0.06.

4.2 Stationary test variables

For stationary test variables in this study, the unit root test of Dickey–Fuller (ADF) is used, and the results are presented in Table (4). According to Table (4), all the variables in levels are stationary, and the confidence level of all the variables is 1%.

Table 4. Stationary test variables

Variable name	Dickey–Fuller test	Critical values at the level of 1%	Critical values at the level of 5%	Critical values at the level of 10%	Stationary or non-stationary	Degree of integration
EPU_CHINA_	-4.160	-3.460	-2.870	-2.570	Stationary	I(0)
EPU_GLOBAL_	-3.560	-3.460	-2.870	-2.570	Stationary	I(0)
EPU_US_	-5.120	-3.460	-2.870	-2.570	Stationary	I(0)
GPR	-6.110	-3.460	-2.870	-2.570	Stationary	I(0)
GPR_CHINA_	-3.870	-3.460	-2.870	-2.570	Stationary	I(0)
GPR_USA_	-3.680	-3.460	-2.870	-2.570	Stationary	I(0)
TEPIX_RETURN	-3.880	-3.460	-2.870	-2.570	Stationary	I(0)
TEPIX_VOLATILITY	-4.950	-3.460	-2.870	-2.570	Stationary	I(0)

Source: research calculations

The estimation results are presented in Table (5):

According to the research findings in Table (5), EPU_Global and EPU_China significantly affect the return of the Iranian stock market. According to the edf statistics, this effect is nonlinear. The findings show that EPU_US does not significantly affect the return of the Iranian stock exchange. The triple findings related to GPR also show that GPR and GPR_CHINA have a significant effect on the return of Iranian securities, but GPR_USA does not have a significant effect. The effects of GPR are linear according to the level of edf. Finally, the significance analysis of two types of simultaneous uncertainty with the same origin shows that EPU and GPR significantly affect all three sources of China, the United States, and the Global. According to the edf statistic, simultaneous uncertainty with the origin of China and the United States has a nonlinear relationship; the findings of the research show the necessity of simultaneous investigations, considering that the possibility of identifying simultaneous effects can only be identified through the GAM model, the results show It shows that it is necessary to pay attention to simultaneous

effects. According to the findings, EPU and GPR related to the United States do not have a significant role individually, but the simultaneous examination of the two has a significant role.

Table (5) shows each variable's significance and the linear or nonlinear relationship. A smooth function was used to show the effects, and only the graphs whose significance was confirmed according to Table (5) were presented. First, the Smooth function related to single variables is presented in Figure 1:

Table 5. Estimation results of the model1; SE stands for the standard error of the parameter estimate. ‘‘edf’’ represents the effective degrees of freedom of the functional parameters and Ref. df is the Reference degrees of freedom

Parametric coefficients					
	Estimate	**SE**	**t value**	**p-value**	
(Intercept)	0.020	0.011	1.788	0.075	.
Approximate significance of smooth terms					
	edf	**Ref.df**	**F**	**p-value**	
s(EPU_Global_)	7.768	8.577	2.406	0.010	*
s(EPU_China_)	7.932	8.655	4.251	0.000	***
s(EPU_US_)	1.000	1.000	1.288	0.250	
s(GPR)	1.000	1.000	3.836	0.050	.
s(GPR_CHINA_)	1.000	1.000	4.591	0.030	*
s(GPR_USA_)	1.000	1.000	1.162	0.390	
ti(EPU_Global_,GPR)	1.000	1.000	2.878	0.090	.
ti(EPU_China_,GPR_CHINA_)	2.386	2.777	5.734	0.000	**
ti(EPU_US_,GPR_USA_)	5.570	6.972	4.095	0.000	***
Signif. codes: 0.000 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’					
R-sq.(adj)	0.452		Deviance explained	54.6%	
Durbin-Watson stat	1.65				

Source: research calculations

According to Figure 1, a Smooth function related to four single and significant variables is drawn .According to the methodology presented in part 3, in the single-variable Smooth function, the horizontal axis shows the values related to the independent variable and the vertical axis shows the influence of the dependent variable on the changes of the independent variable .In the top left figure, the effectiveness of the return of the Iranian stock market from EPU-Global is shown. According to the figure, global economic policy uncertainties up to values of 300 units in EPU_Global cause a decrease in the return of the Iranian Stock Exchange; for values greater than 300 units, it causes an increase in return, the upper and right figure of the relationship between EPU_CHINA and the market It shows the Iranian stock market, according to the figure, there is a nonlinear relationship for values up to about 300 units, the relationship is negative, for values between 300 and 600, there is a positive relationship, and after several volatility in other values, for very high values High in EPU_CHINA causes a significant drop in stock market returns.

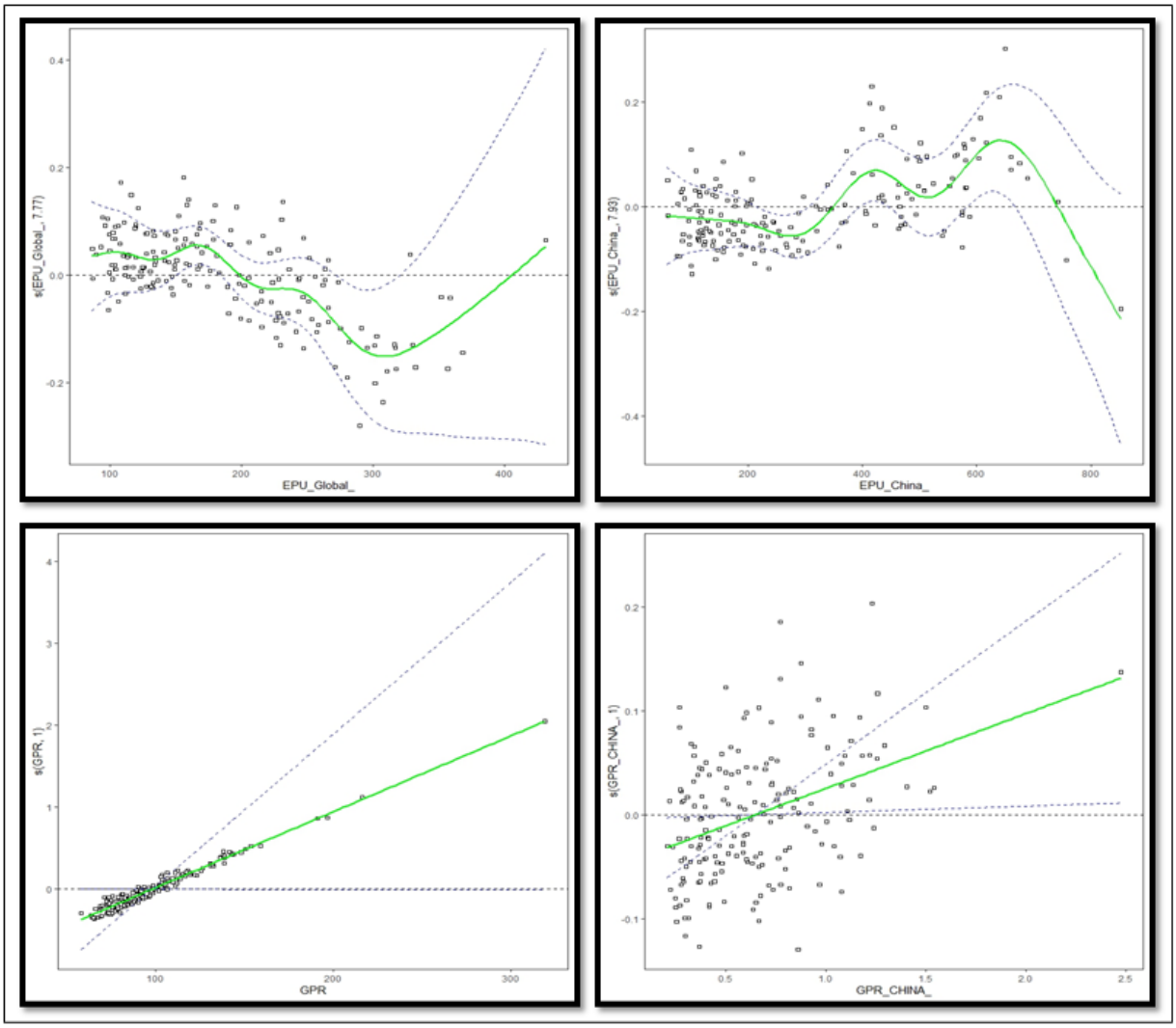

Figure1. Smooth function related to the effects of single variables on the returns of the Iranian stock market

The two figures below show the relationship between GPR of global origin and GPR of Chinese origin on the return of the Iranian stock market; the findings show that the uncertainty of GPR with global and Chinese origin increases the return of the Iranian stock market, this relationship It is linear, in other words, the results show that if there is uncertainty in the geopolitical sphere, Iranian investors perceive the Iranian stock exchange as a safe asset, there is no significant relationship between the EPU and the origin of the United States. GPR with the origin of the United States on the return of the Iranian stock exchange, shows that, from the point of view of investments, the occurrence of each of the factors individually will not have an impact on the economy of Iran.

In the following, the smooth function related to the simultaneous effects of uncertainties with global origin on the return of the Iranian stock market is presented in Figure 2:

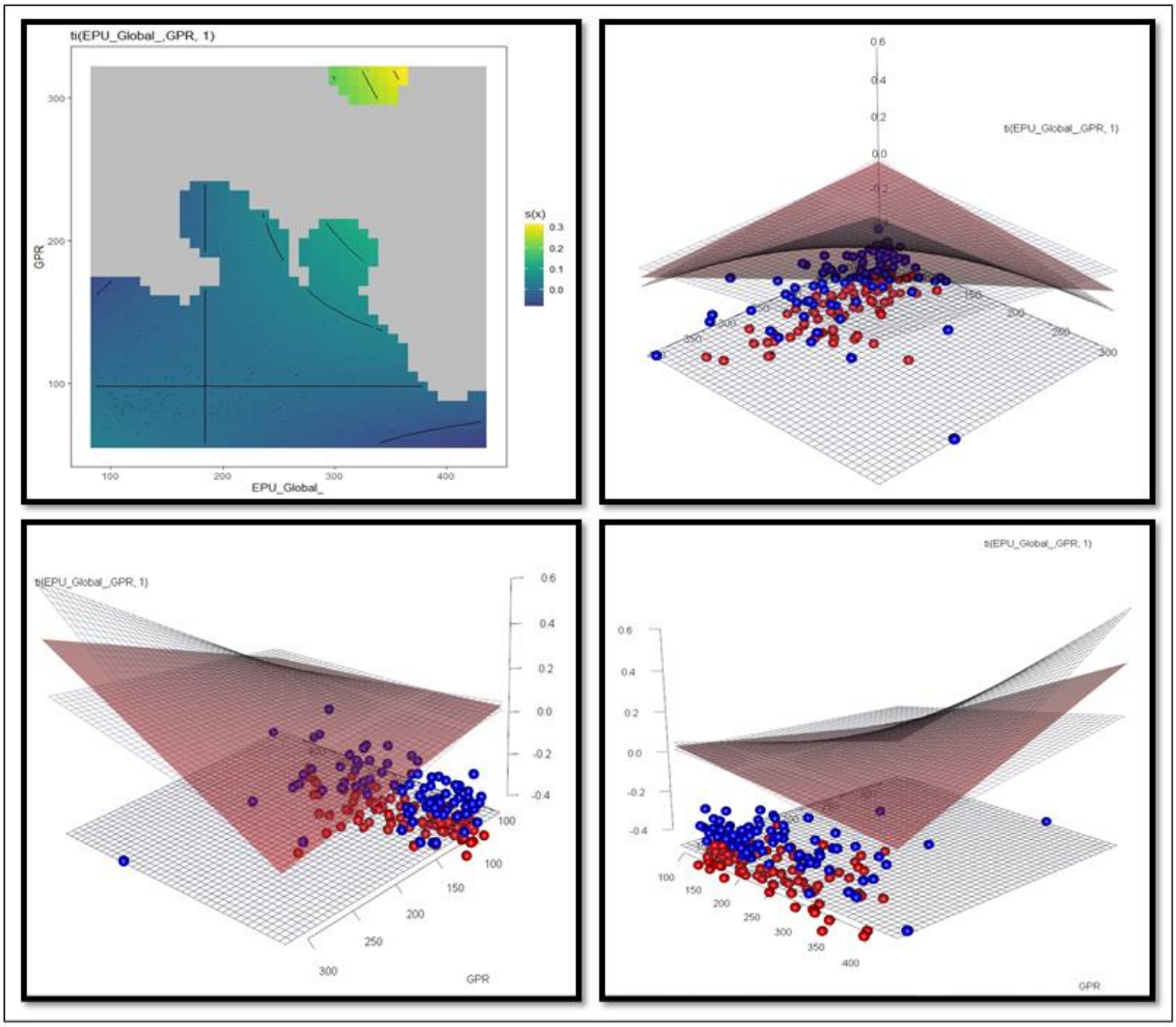

Figure 2. Smooth function related to the effects of simultaneous variables with global origin on the returns of the Iranian stock market

According to Figure 2, in the upper right image, EPU_Global is shown on the horizontal axis, GPR on the vertical axis, and the influence of the return of the Iranian stock market on the third axis. The parts shown in light color are the sets that have a historical record, the parts marked with muted color (gray) show the sets that do not have a historical record (such pairs as Figure. have not been taken), the other three images show the effectiveness of the return of the Iranian stock market (according to the GAM methodology for all the sets that have been formed and the sets that do not have historical data with this combination), the findings It shows that the simultaneous increase in EPU_Global and GPR causes a significant increase in the return of the Iranian stock market. The increase of each of the uncertainties, in a situation where other uncertainties do not occur, reduces the efficiency of the Iranian stock market.

Figure 3 shows the effectivity of the Iranian stock market's return on China's uncertainties.

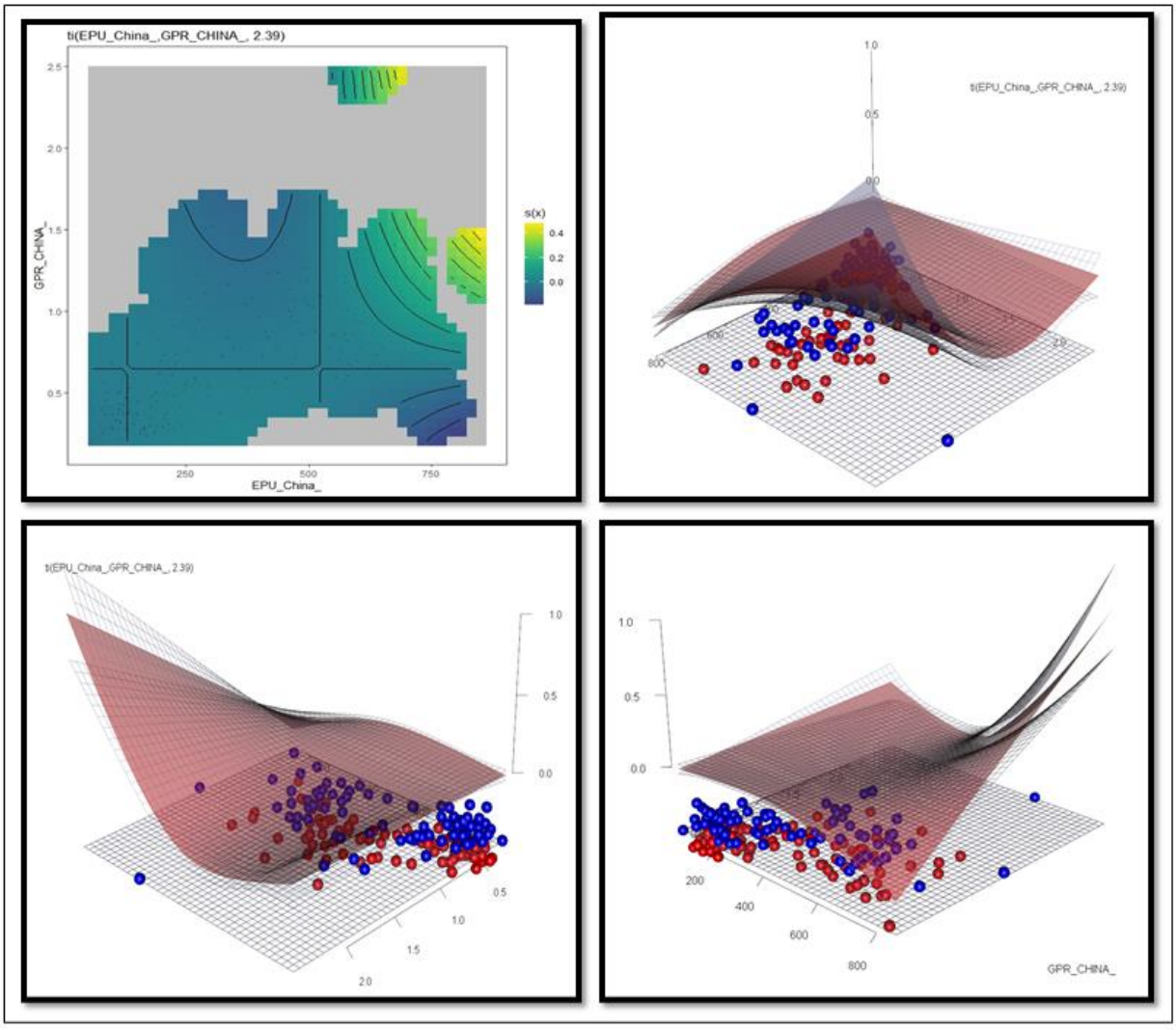

Figure 3. Smooth function related to the effects of the simultaneous variable with the origin of China on the return of the Iranian stock market

According to Figure 3, the simultaneous increase in EPU_CHINA and GPR_CHINA causes a significant increase in the return of the Iranian stock market, and the increase in EPU_CHINA in small amounts of GPR_CHINA causes a drop in the return of the Iranian stock market. An increase in EPU_CHINA at small values of GPR_CHINA increases the return .The rest of the compounds in the values of two uncertainties with the origin of China and the effects on the return are shown in Figure 3.

Figure 4 shows the influence of the Iranian stock market returns on the uncertainties of the United States.

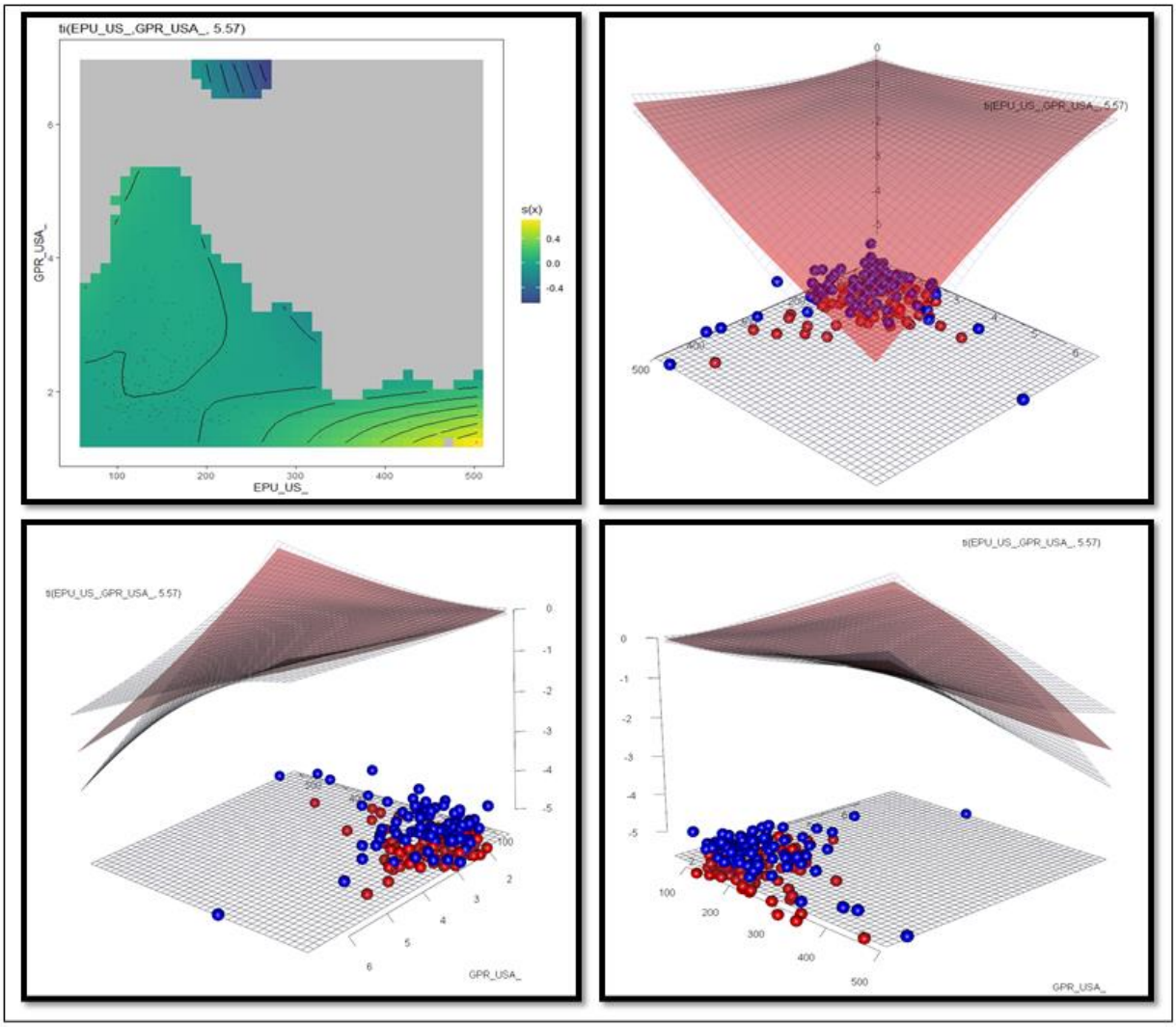

Figure 4. Smooth function related to the simultaneous variable effects of the country of origin of the United States on the returns of the Iranian stock market

According to Figure 4, the simultaneous increase in EPU_USA and GPR_USA causes a decrease in the return of the Iranian stock market, an increase in each of the uncertainties with the origin of the United States, in the condition that the other uncertainty is insignificant, does not affect the return of the Iranian stock market, but binary combinations of the uncertainties of the United States reduce the return of the Iranian stock market.

By putting together the results of the simultaneous effects with the global origin, China and the United States, it shows that the simultaneous increase in EPU and GPR with the origins of China and the United States increases the return of the Iranian stock market. Still, the simultaneous increase In the uncertainties with the origin of the United States causes the return to fall.

At the same time, the United States is the largest economy on the planet and has about one-fifth of global production, energy demand, foreign direct investment (FDI), one-tenth of global trade and one-third of the stock market value, but comparing the sources of risk in the United States, China and Global, shows that the reaction of Iran's stock market returns to global and Chinese origins is

exactly the same and is in contrast to the results of the United States, this finding can be justified considering the political tensions between Iran and the United States.

In general, the occurrence of uncertainties in China and globally encourages investors to increase capital in the financial markets; this behavior can be argued for several reasons:

First, it may be perceived that uncertainties enter Iran's economy; therefore, by investing in the financial market as a safe asset, they seek to preserve the value of money.

Secondly, the occurrence of uncertainty in Iran's commercial parties and comparing it with Iran's conditions will signal to investors that the relative performance of Iran's economy has increased and they will increase the amount of investment in the stock market.

4.3 Robustness check (The impact of uncertainties on the monthly volatility of the Iranian stock market)

According to Table (6) (presented in the appendix), the estimation results show that the effect of EPU with all three origins (global, China and the United States) on the volatility of the Iranian stock market is significant. Also, the impact of GPR with global origin and China is significant; the GPR of the United States, similar to the results obtained in model 1, does not have a significant effect on the volatility of the Iranian stock market; also, the effects of GPR are linear like the results of model 1, in the effects related to simultaneous uncertainties with a fixed origin, simultaneous uncertainty with a global origin does not affect volatility, the effect of simultaneous uncertainties with the origin of China is significant and is linear and the effect of simultaneous uncertainties with the origin of the United States is significant and nonlinear.

Examining the Smooth function related to the single variables according to Figure 5 (provided in the appendix) shows that the EPU with the global origin and the United States country causes a decrease in volatility. In contrast, the EPU, which originated in China, causes an increase in volatility. The relationship between GPR with global origin and China is positive and linear, similar to the effect on returns.

Examining the Smooth function related to the simultaneous variables, according to Figure 6 and Figure 7 (provided in the appendix), shows that the simultaneous increase in uncertainties with the origin of China causes an increase in volatility, but the simultaneous increase in uncertainties with the origin of the country The United States reduces the volatility of the Iranian stock market.

5. Conclusion

This research tested the effects of two types of uncertainty (EPU and GPR) with three global origins, China and the United States, on the returns and volatility of the Iranian stock market.

The results show that EPU_Global and EPU_CHINA significantly affect the return of the Iranian stock market; this effect is nonlinear and is negative for the initial values and then positive. These findings in terms of reducing returns are in accordance with the findings of **(**Das and Kumar, 2018**;** Hu et al., 2018**;** Kido, 2018**;** Liang et al., 2020**),** but the findings of this research show that the relationship is only within a certain range and from then on the relationship The form is positive and significant, therefore, in terms of examining the relationship with respect to different uncertainty values, this article is innovative. Also, the results show that EPU_US has no significant effect on the performance of the Iranian stock market; this finding shows a relationship. A

meaningful relationship between the economies of the two countries is one of the requirements to be affected by the EPU of that country.

In terms of examining the effects of GPR on the return of the Iranian stock exchange, the results show that the GPR with its global and Chinese origin increases the return of the Iranian stock market, this finding is in contrast with the results of the studies of Arfaoui and Naoui (2022) and Rawat and Arif (2018) and are consistent with the findings of Ramiah et al. (2010) and Cam (2008), the argument of Cam (2008) is that GPR increases the demand for weapons, ammunition, some food, etc., and in this sense, the stocks of those sectors may have increased returns, The argument of Ramiah et al. (2010) also states that capital market activists may not understand the impact of GPR and it does not cause changes in returns, but the results of studies related to Iran show a new theory, with the occurrence of GPR investors in the Iranian stock market, This market is considered as a safe asset and the occurrence of GPR is considered as an incentive to enter the capital market in Iran, the origin of GPR is also important, GPR is related to countries with which Iran's economy has serious interactions.

Examining the simultaneous effects in this research shows that in response to two simultaneous events, investors show behavior that cannot be calculated by comparing their individual effects, for example, the effect of GPR and EPU of the United States individually on the return of the Iranian stock exchange is not significant, but the simultaneous effect of these two causes a decrease in return.

The effects of the mentioned variables on the fluctuations of the Iranian stock exchange have also been investigated; in examining the effects of EPU with different origins, the results show that EPU with Chinese origin causes a significant increase in volatility, but EPU with global and US origin causes a decrease in volatility. Past studies show that EPU increases volatility; studies such as Su et al. (2019) and Dakhlaoui and Aloui (2016), it can be argued that EPU can affect volatility in two ways:

1- It causes a sudden shock and actually the investors enter the "sit and watch" mode.

2- They cause quick decisions to be made.

By comparing the argument presented with the findings, it can be said that seeing China's EPU by investors will mean the occurrence of a series of specific effects on the economy, so they start to change their portfolio, but seeing EPU with the origin of the United States and Globally, it is not recognizable for investors, so they prefer not to take action.

Investigating the effects of GPR on the volatility of the Iranian stock market shows that GPR with Chinese and global origin increases volatility; this finding is in line with the findings of the studies of Salisu et al. (2022), Ndako et al. (2021), Chiang (2021) and Zhang et al. (2023) is consistent, also the GPR with the origin of the United States has no effect on the volatility of the Iranian stock market, this finding is in contrast with the mentioned studies and consistent with the result of the study of Bouras et al. (2019).

The results of this research are useful for investors and financial market participants; it also shows a new point of view on the necessity of examining the variables; at the same time, it also shows that the level of commercial and political communication has a significant role on the influence of financial markets, for future studies it is suggested that the text mining indicators related to GPR and EPU for The country of Iran should be extracted and then their effects on the return and volatility of the financial market of Iran should be investigated.

6. Appendix

Table 6. Estimation results of the model2; SE stands for the standard error of the parameter estimate. ‘‘edf’’ represents the effective degrees of freedom of the functional parameters and Ref. df is the Reference degrees of freedom

Parametric coefficients					
	Estimate	**SE**	**t value**	**p-value**	
(Intercept)	0.04180	0.00715	5.841	0.00	***
Approximate significance of smooth terms					
	edf	**Ref.df**	**F**	**p-value**	
s(EPU_Global_)	4.211	5.337	2.072	0.08	.
s(EPU_China_)	6.990	8.029	3.087	0.00	**
s(EPU_US_)	6.260	7.414	1.763	0.08	.
s(GPR)	1.000	1.000	4.403	0.03	*
s(GPR_CHINA_)	1.000	1.000	2.871	0.09	.
s(GPR_USA_)	1.000	1.000	1.065	0.30	
ti(EPU_Global_,GPR)	1.000	1.000	0.828	0.36	
ti(EPU_China_,GPR_CHINA_)	1.000	1.000	3.333	0.07	.
ti(EPU_US_,GPR_USA_)	10.867	11.875	3.245	0.00	***
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1					
R-sq.(adj)	0.648		Deviance explained	74.7%	

Source: research calculations

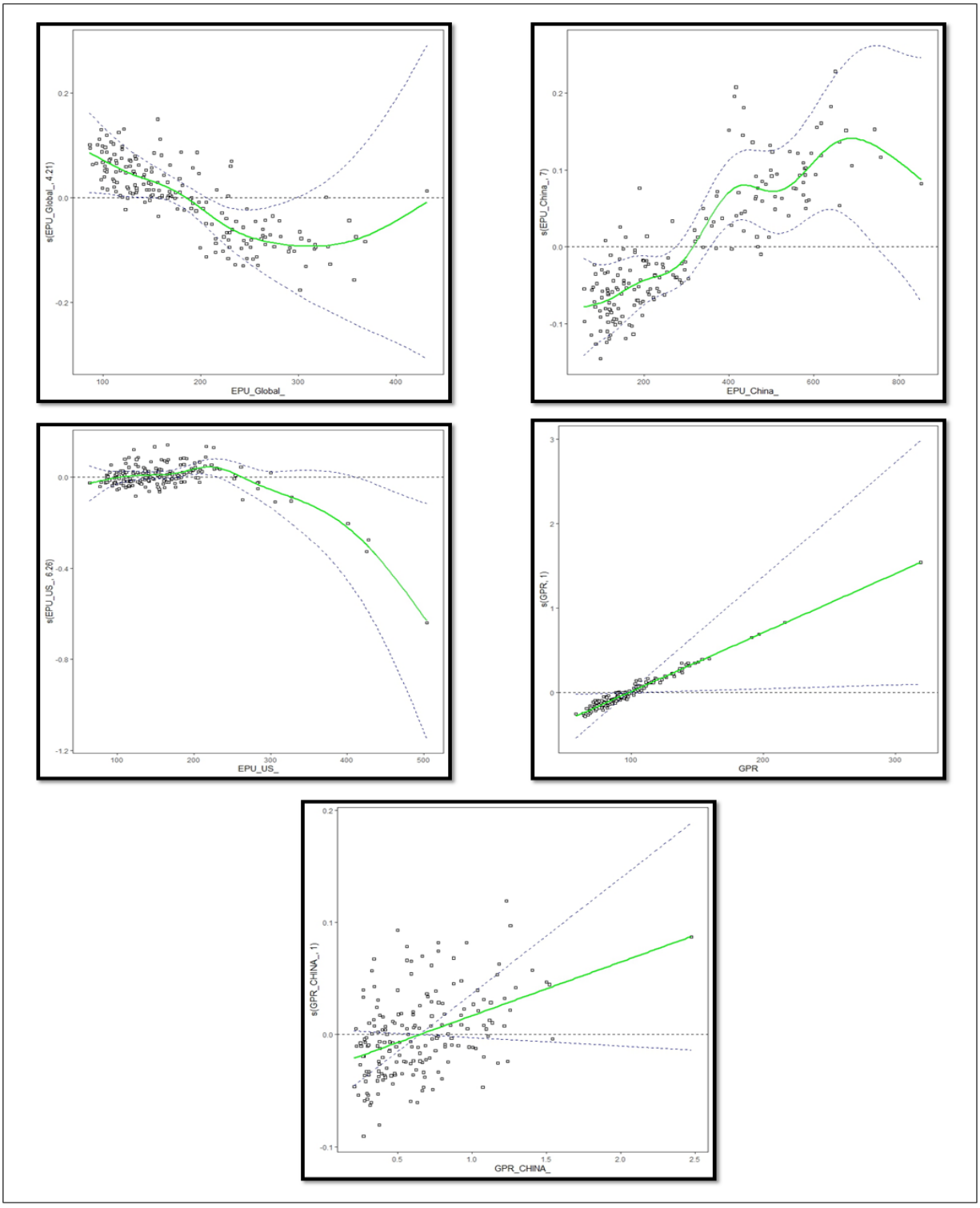

Figure 5. Smooth function related to the effects of single variables on the volatility of the Iranian stock market

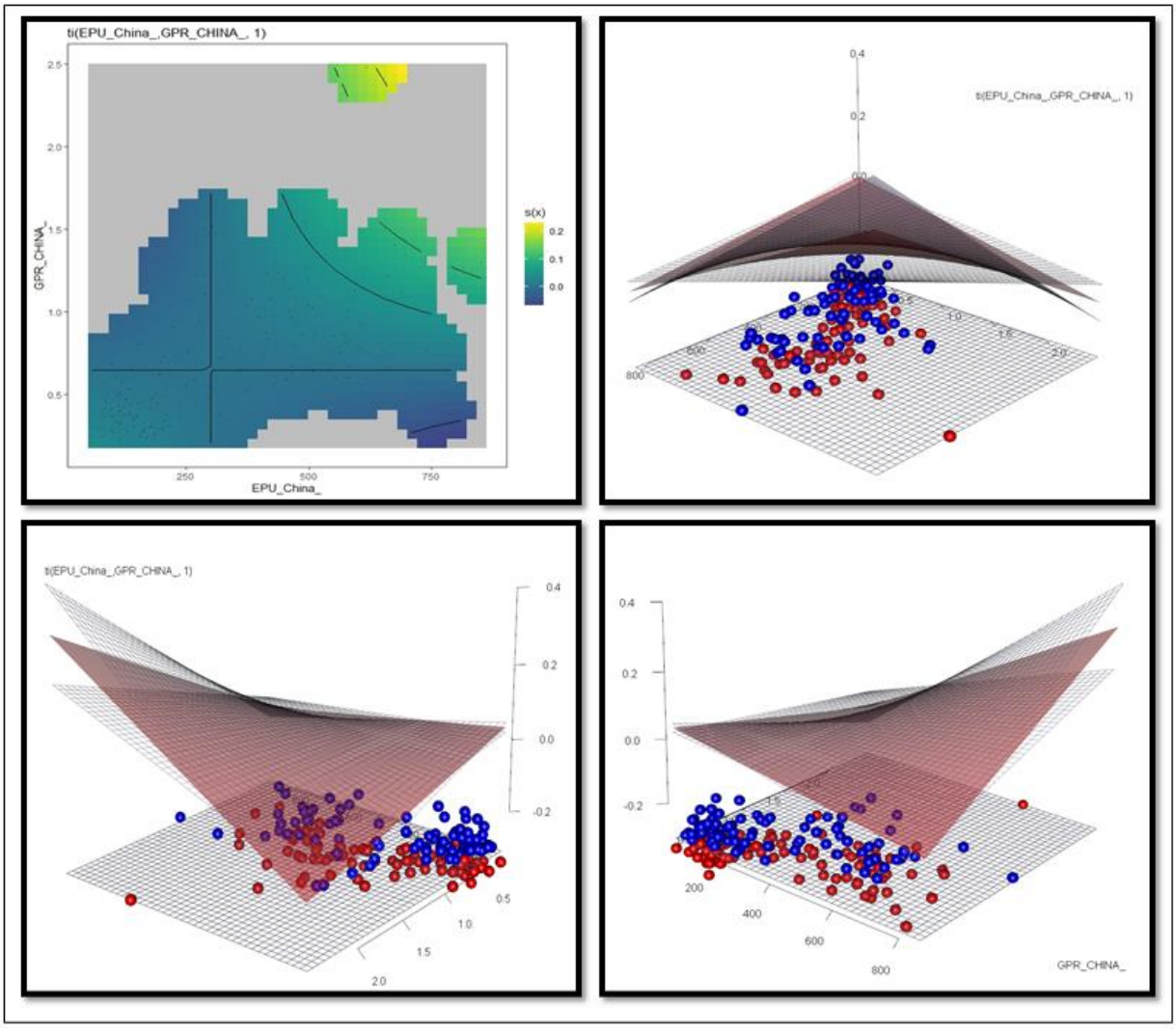

Figure 6. Smooth function related to the effects of the simultaneous variable with the origin of China on the volatility of the Iranian stock market

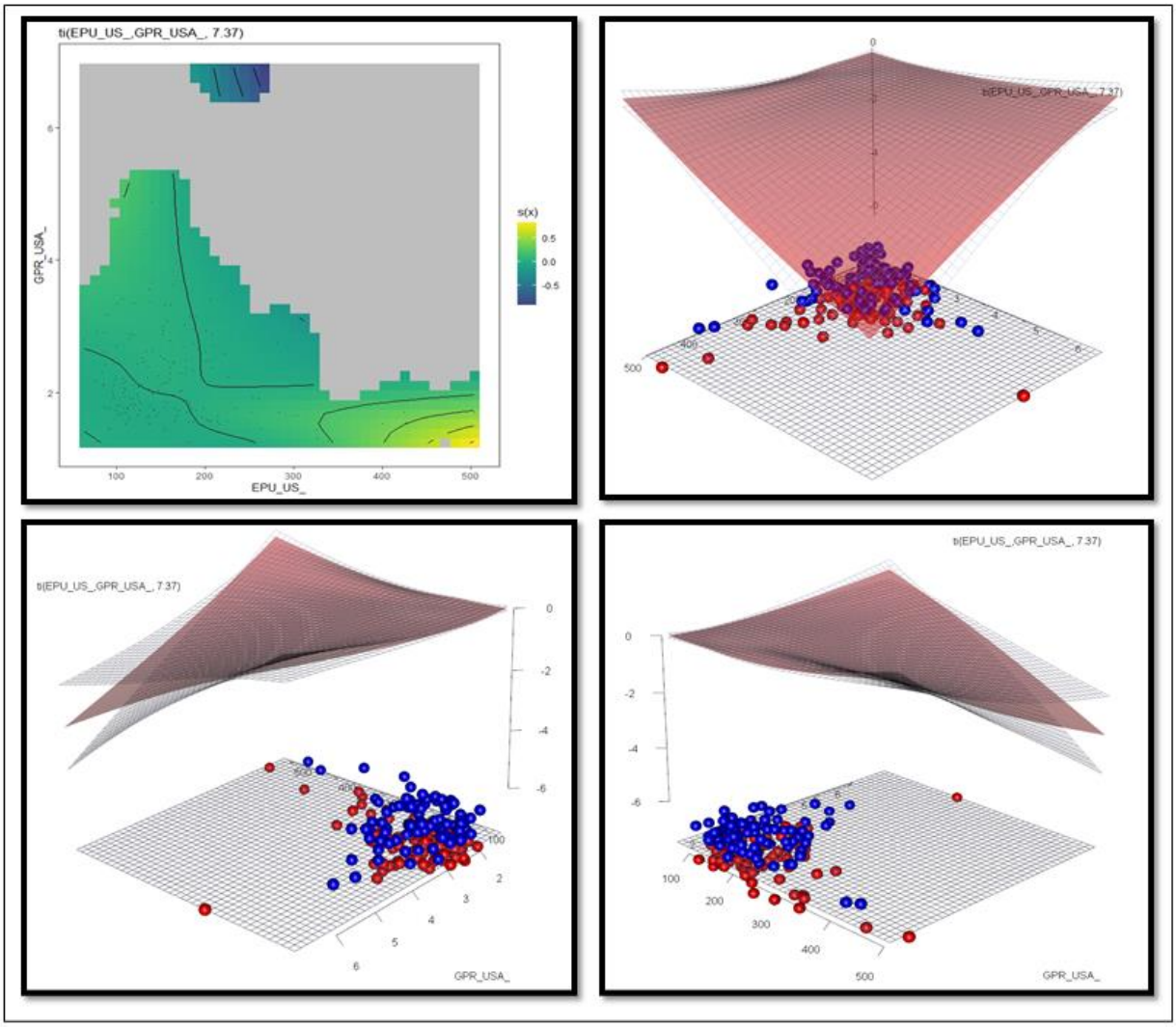

Figure 7. Smooth function related to the simultaneous variable effects of the country of origin of the United States on the volatility of the Iranian stock market

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The Impact of Bankruptcy Risk on Stock Price Crash Risk: The Moderating Role of Debt Maturity

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Abstract

Existing studies rely on agency theory to explain management motivations for hiding bad news. However, investors' irrational beliefs can cause stock prices to fall from their perspective. Whether concealing bad news—meaning a lack of transparency—increases heterogeneity among investors needs to be tested empirically. Developing a direct measure of investor heterogeneity is challenging and may lead research studies to examine its role in causing stock price crashes. In considering default risk as a prerequisite for price declines, a refined representation of default risk—such as breach of debt contracts rather than firm size or leverage—may provide better insight into why companies with high default risk are more prone to crash risk. This study investigates the effect of bankruptcy risk on stock price crash risk, emphasizing the role of debt maturity in companies listed on the Tehran Stock Exchange. The financial statements of 150 companies from 2010 to 2021 were collected for the study. Multivariate regression with panel data was used to test the hypotheses. The results of the hypothesis testing show that the effect of bankruptcy risk on stock price crash risk, with an emphasis on debt maturity, is not statistically significant, leading to the conclusion that the research hypotheses are not supported. The research findings can benefit investors, creditors, policymakers, and regulatory bodies. Additionally, they can effectively improve the quality of financial reporting and economic development by identifying existing weaknesses and challenges and providing insights into theoretical frameworks.

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1. Introduction

Due to the successive financial crises in Europe and Asia, many companies have struggled to raise funds in recent decades. Despite such crises, corporate financing has become one of the most important issues in the financial literature. The turbulent and changing economic environment of companies, characterized by the globalization of markets, changing customer needs, and increasing competition in the product market, forced companies to improve their performance constantly. Companies need sufficient financial resources for their activities and programs (Almeida and Campello, 2001). Lack of cash may cause serious problems for companies, as the managers of such companies will not have sufficient resources to finance investment projects. Recent financial crises have created more incentive to properly examine and predict the risk-fall process of stock prices (Hutton et al., 2009). Numerous theoretical models indicate that company executives are strongly incentivized to hide bad news and delay informing about the end of projects with a net negative present value. When such news accumulates and exceeds certain thresholds, the sudden release of bad news accumulated in the market will cause stock prices to fall (Benmelech et al., 2010; Bleck and Liu, 2007; Jin and Myers, 2006). In relation to traditional agency theory, the conventional feature of this type of theoretical model is that managers are considered to be a group of individuals who should reasonably be able to maximize the expected usefulness of the company. Still, at the same time, this group of managers may also jeopardize the company's ethical issues.

The stock price crash risk and various approaches, as well as the sudden fluctuations in stock prices in recent years, especially after the financial and economic crisis of 2008, have attracted much attention. These changes generally occur in the form of falling and rising stock prices. Given the importance that investors attach to their stock returns, the falling stock prices, which lead to a sharp decline in returns, have received more attention from researchers than stock price growth.

Blanchard and Watson (1982) introduced the random stock price bubble in describing the negative skewness of the stock return. According to modern financial theories, the value of a share is equal to the total present value of its future cash flows. Also, according to the efficient market hypothesis, the stock price in an efficient market fluctuates equally to or around its intrinsic value. But sometimes, due to a shock (release of new information, etc.), prices rise without any fundamental and economic justification; in other words, stock prices take a significant upward trend. This process is referred to as the price bubble. Blanchard and Watson believe that the bursting of price bubbles causes the negative skewness of stock returns or falling stock prices. French et al. (1987) and Campbell and Hentschel (1992) explained the reverse oscillation mechanism to explain the stock price crashes or negative skewness of stock returns. According to this procedure, the entry of new news (information) into the market, both favorable and unfavorable, leads to increased market volatility and, therefore, the risk will increase. Although this increase in risk reduction somewhat reduces the positive effect of good news, it reinforces the negative effect of bad news. Thus, the decrease in stock prices due to the entry of unfavorable news into the market will be greater than the increase due to the entry of favorable information. This mechanism leads to a negative skewness of stock returns or a stock price crash. Potterba and Summers criticized this mechanism. They believe market fluctuations are short-lived and cannot be expected to significantly affect risk alone (Hong and Stein, 2003).

From the necessity and importance of its research, it can be said that one of the constant concerns of investors is the unfavorable financial situation of the company. Poor financial

performance and persistence can lead to the company's bankruptcy. For this reason, financial turmoil will have significant adverse consequences, and one of its main effects is investors' fear of the company's future and the risk of falling stock prices. Suppose the company is in an unfavorable financial situation. In that case, it will have consequences such as reducing the credit of the company's managers and their salaries and benefits, which will increase agency costs (Leuz et al., 2003). Stability in the company's financial situation and no turmoil reduces the cost of representing the company and increases its market value. Topics on stock price crash risk rely heavily on arguments based on the agency theory for management incentives to hide bad news. However, the investor's heterogeneous belief can cause prices to fall from the investor's perspective. Whether concealing bad news - that is, lack of transparency - increases heterogeneity among investors needs to be tested empirically. Developing a direct scale of investors' heterogeneous beliefs is a challenging task that may lead to research examining the role of investor heterogeneity in causing a crash. Concerning default risk as a prerequisite for price falls, a refined representative of default risk - for example, breach of debt contract rather than firm size or leverage can be helpful in better understanding why companies with high default risk are more prone to crash risk. This study investigates the effect of bankruptcy risk on stock price risk, emphasizing debt maturity in companies listed on the Tehran Stock Exchange.

2. Theoretical principles and hypothesis development

2.1 The fall in stock prices has the following characteristics

A) a stock price crash is a large and unconventional change in stock prices without a major economic event; B) these large changes are negative; C) Falling stock prices are a contagious phenomenon at the market level. This means that stock price reductions are not limited to a specific stock but include all types of stocks available (Chen et al., 2001).

A considerable body of research theorizes that the desire of managers to preserve their wealth and human capital incentivizes them to strategically withhold bad news, which can keep investors' expectations at unjustifiable levels and inflate a firm's stock price beyond its intrinsic value at the expense of shareholders (e.g.Jin and Myers, 2006; Bleck and Liu, 2007; Benmelech et al., 2010). Accordingly, such opportunistic behavior prolongs investors' false impression of the firm's true state of economic fundamentals (Hutton et al., 2009; Kim et al., 2011a). Keeping the deception up is naturally unsustainable in the long-term and when the volume of negative information becomes overwhelming, managers tend to give up. At that point, the accumulated negative information abruptly spills into the market, causing a firm-specific stock price crash. The burgeoning literature attributes firm-specific stock price crashes to agency-related problems arising from managerial opportunism, which fuels the bad news hoarding mechanism (e.g. Hutton et al., 2009; Kim et al., 2011a; Callen and Fang, 2013; Andreou et al., 2017). From a different perspective, a number of other studies show that managers of firms facing rising bankruptcy risk situations act opportunistically to obfuscate their firm's poor operating performance; for example, by influencing contractual outcomes or misleading stakeholders about their firms' economic fundamentals (DeAngelo et al., 1994; Rosner, 2003; Andreou et al., 2017). Research also suggests that the link effect bankruptcy risk on managers' career concerns represents one of the reasons why managers persistently withhold bad news. Taking these ideas on board, we hypothesize that the negative externalities associated with rising financial distress risk incentivize managers to persistently withhold bad news from investors, a strategy that increases firms' susceptibility to future stock price crashes. Despite the plausibility and researchworthiness of this proposition, to the best of our knowledge, studies have yet to meticulously investigate the relationship between financial distress

risk and the future occurrence of stock price crashes. In this respect, our study fills this gap by seeking to empirically discover a positive distress-crash risk relationship.

Each of these characteristics is rooted in empirical, reasoned, and fundamental facts; regarding the first feature, Hong and Stein (2003) state that many of the major changes that have taken place in the S&P Index since World War II, and in particular the market crash in October 1987, have not been due to the disclosure of news about an important and significant event. Similarly, French et al. (1987) emphasize that it is very difficult to explain stock price changes by disclosing information about a particular event in many cases. The second characteristic of the above definition is an empirical and significant asymmetry in changes in market returns. This means that large price changes have resulted in more decreases and fewer increases. In other words, market returns were more likely to decline and less likely to increase. This asymmetry can be proved in two ways. First, this asymmetry can be clearly seen by looking at historical market returns data. An examination of these data shows that of the 10 major changes that have taken place in the S&P index since 1947, 9 have been reduced. A large part of the stock market literature indicates that stock returns over time indicate a negative skew of stock returns or asymmetric fluctuations in stock returns (Chen et al., 2001).

The third characteristic of defining a stock price fall is that a fall is a phenomenon that pervades the entire market. This means that this phenomenon spreads to all types of stocks in the market. Duffee (1995) states that this is because the correlation between the types of stocks in the market increases at the time of the collapse; Kelly (1994) proved that the study of historical price data trends related to the market price of stock options shows that in cases where the stock option price index has decreased, the correlation between different types of stock options has increased.

In general, the stock price crash risk equating to the negative skewness of stock returns is statistically defined as follows: stock price crash in the capital market occurs when in a company-specific monthly return over some time, 2.3 of standard deviation is less than the average specific monthly return of the company during the same period. This definition is based on the statistical concept that assuming the normal distribution of the company's specific monthly returns, fluctuations between the average plus 2.3 standard deviations and the average minus 2.3 standard deviations are among the normal fluctuations and those outside this distance are considered abnormal. Since the stock price crash is an abnormal fluctuation, 2.3 is considered the boundary between normal and abnormal fluctuations (Healy and Wahlen, 1999). Although all experts agree on negative asymmetry or negative skewness in stock market returns, the economic mechanism that leads to this phenomenon has not been clearly defined (Hutton et al., 2009). In the financial texts, various theories and approaches have been presented to explain the phenomenon of falling stock prices.

Cao et al. (2002) propose the "information blockage" model as another theoretical framework to explain price fall. In this model, the upward price trend causes informed investors to engage in active trading. Conversely, uninformed traders are naturally skeptical about the true nature of the marks and consequently delay trading until the price drops. Therefore, a price correction is inevitable when the pessimistic economic outlook and the final investors are less informed. As a result, information blockage leads to negative skewness of returns following the price increase but leads to positive skewness following the price decrease (Zhu, 2016). Another source of crash risk is the effects of volatility feedback, whereby large price movements can cause investors to re-evaluate market fluctuations and increase the required risk. Merely increasing risk reduces the balanced prices, reinforcing the effect of bad news but balancing the effect of bad news, resulting in negative skewness (Hutton et al., 2009).

The default risk-based explanation for crash risk relies on the argument that companies with

higher default risk are more likely to publish bad news or extremely good news because they have failed or continue to operate. The previous literature used firm size and leverage as representatives of default risk but failed to support that (Hutton et al., 2009; Kim et al., 2011a and b). Conversely, a negative correlation between leverage and fall risk is proven when leverage positively correlates with bankruptcy risk (Campbell et al., 2008). A potential explanation for this result is probably the fact that investors initially undervalue high-leverage companies and, as a result, are less likely to fall in price. Consistent with this explanation, Campbell et al. (2008) show that companies with high leverage have higher future average returns than companies with low leverage (Zhu, 2016).

2.2 The impact of bankruptcy risk on stock price crash risk

Firms facing financial constraints face a gap between domestic and foreign spending of allocated funds. When the difference between domestic and foreign spending on investing in a firm is large and high, that firm is more financially constrained. Financial constraints generally prevent the provision of all necessary funds for the firm's desired investment. Financial constraints encourage managers to hide unfavorable news about the firm because investors' knowledge of financial constraints may affect the company's stock price. Managers who can not maintain unfavorable information about financial constraints are forced to disclose this information. Thus, releasing information causes severe price fluctuations and, as a result, stock price crash risk.

Hypothesis 1: Bankruptcy risk significantly affects the stock price crash risk.

2.3 The role of debt maturity in the effect of bankruptcy risk on stock price crash risk

Jin and Myers' (2006) model is the most widely accepted paradigm in crash risk literature regarding information structure dynamics. According to this model, the withheld negative information spills into the market abruptly and all at once at the point where managers give up (i.e. become unwilling or unable) to continue concealing it. Nevertheless, based on the arguments above (e.g. Hong and Stein, 2003; Roychowdhury and Sletten, 2012; Callen and Fang, 2013), it is reasonable to assume that at least a portion of the hitherto undisclosed bad news that managers are strategically concealing from the market spills into the market in the short period preceding the tipping above point. In this respect, the discovery of such negative information increases the firms' bankruptcy risk level within a short period of time, as investors start revising their expectations downwards regarding the firms' true state of economic fundamentals.

One of the things that can lead to a possible decline in stock prices is short-term debt. Debt is one of the financial instruments for raising capital. The debt maturity structure mainly influences the company's investment decisions and the investor in debt financing texts. Due to defective debt contracts, creditors may not be able to exercise their right of control over any possible future events under the terms of the contract. However, short-term debt provides better protection for creditors' right to control by threatening not to extend the debt contract, so creditors will demand more control to repay the debt (Giannetti, 2003). Given the control right granted by the short-term debt, lenders can better control the borrowers (the company) and obtain more reliable information about the company's operating performance before re-granting credit (Dang et al., 2018). Since one of the reasons for the sharp decline in stock prices is the accumulation of bad news by managers in line with their interests, to reduce the risk of losing their claims, lenders are expected to demand control rights as well as reliable information about the company's status, which will reduce the risk of hiding bad news and lead to a sharp drop in stock prices.

Hypothesis 2: Debt maturity moderates the effect of bankruptcy risk on stock price risk.

3. Research methodology

3.1 Research method

This research is correlational in nature and content and practical in purpose. The research is conducted within the framework of deductive-inductive reasoning, which means that the theoretical foundations and background of the research are done through libraries, journals and other valid sites in deductive form, and data is collected to confirm and refute hypotheses inductively. Also, considering that the data used in the present study is real and historical information, it can be classified as a retrospective type.

3.2 Data analysis method

Due to the type of data studied and the simultaneous comparison of cross-sectional and longitudinal data, the panel data model method (data panel) has been used to estimate the coefficients and test the hypotheses. First, the F-Limer test was used to determine the method of using panel data and whether they are homogeneous or heterogeneous. In this test, the null hypothesis is that the data is homogeneous. If confirmed, all data should be combined and a classical regression should estimate the parameters; otherwise, the data should be considered panel data. If the results of this test are based on using data as panel data, one of the fixed or random-effects models should be used to estimate the research model. The Hausman test must be performed to choose one of the two models. The null hypothesis of the Hausman test is that the random-effects model is appropriate for estimating panel data regression models.

3.3 Statistical population and sample

The statistical population of this research includes all companies listed on the Tehran Stock Exchange. The research period is from 2010 to 2021. Also, in this research, a sample of 167 companies has been selected from the statistical population of companies listed on the Tehran Stock Exchange based on the following criteria:

1. According to the period of access to data of listed companies on the stock exchange before 2010 its name has not been removed from the list of companies mentioned until the end of 2021;
2. In order to increase the ability to assess and equalize the conditions of selected companies, the financial year of the companies should end at the end of March of each year;
3. Due to the lack of clear demarcation between operational activities and financing of financial companies (investment and financial intermediation companies, etc.), these companies have been excluded from the sample;
4. Companies whose information was incomplete to calculate the initial variables of the financial statements have been excluded from the sample.

Table 1. The statistical population of the research

All companies accepted in 1399	**517**
Limitations	
Inactive companies	185
Companies accepted and listed after 1392	52
Intermediary companies, finance, insurance, banks and holdings	57
Companies end of the fiscal year other than March 20	54
Lack of access to data	2
Total companies studied	167

3.4 Research variables

Given the proposed facts, the models and variables of the study are as follows:

$Z\_Altman_{it} = \beta_0 + \beta_1$ Stock Price Crash Risk $_{it} + \beta_2$ Size $_{it} + \beta_3$ Financial Leverage $_{it} + \beta_4$ Sale

Growth $_{it}$ + β_5 ROA $_{it}$ + β_6 BV/MV $_{it}$ + ε_{it}

Z_Altman $_{it}$ = β_0 + β_1 Stock Price Crash Risk $_{it}$ + β_2 Debt Maturity $_{it}$ + β_3 Stock Price Crash Risk $_{it}$ × Debt Maturity $_{it}$ + β_4 Size $_{it}$ + β_5 Financial Leverage $_{it}$ + β_6 Sale Growth $_{it}$ + β_7 ROA $_{it}$ + β_8 BV/MV $_{it}$ + ε_{it}

Dependent variable: stock price crash risk

The negative skewness criterion of stock returns is used to measure this variable. To measure the stock price crash risk, the company's specific monthly return is first calculated using Equation (1):

Equation (1)
$$W_{j,\theta} = Ln(1+\varepsilon_{j,\theta})$$

Where

$W_{j,\theta}$: the net monthly return of company j in the month θ

$\varepsilon_{j,\theta}$: The residual return on the stock of the company j in the month θ and is the residual the model in equation (2)

Equation (2)
$$r_{jt} = \alpha_j + \beta_{1j} r_{m,t-2} + \beta_{2j} r_{m,t-1} + \beta_{3j} r_{m,t} + \beta_{4j} r_{m,t+1} + \beta_{5j} r_{m,t+2} + \varepsilon_{jt}$$

Where

rjt: the return of stock of the company j in the month θ during the fiscal year

rm,θ: market return in month θ. To calculate the monthly market return, the beginning of the month index is deducted from the end of the month index and the result is divided by the beginning of the month index.

Then, using the company-specific monthly return, the negative skewness of stock returns and falls is calculated as follows:

Chen et al. (2001) believe that the signs of falling stock prices form one year before this phenomenon, and one of these signs is the existence of a negative skew in the company's stock returns. Therefore, companies that have experienced negative stock returns in the past year will likely face falling stock prices next year. Hong and Stein (2003) also stated that the negative skewness of stock returns is an alternative way to measure asymmetry in the distribution of returns. Equation (3) is used to calculate the negative skewness of stock returns:

Equation (3)
$$NCSKEW_{j,t} = -\frac{[n(n-1)^{\frac{3}{2}} \sum W_{j,t}^3]}{[(n-1)(n-2)(\sum w_{j,t}^2)^{\frac{3}{2}}]}$$

Where

NCSKEWjt: negative skew of monthly stock return of company j during the fiscal year t.

$W_{j,\theta}$: the net monthly return of company j in the month θ

N: number of months, the return of which is calculated.

In this study, the Altman criterion was used to assess financial constraints. According to the definition, this risk comprises those business units that stop their operations due to the transfer or bankruptcy or cessation of business operations or losses by creditors. In this study, the modified Altman (1983) model was used to measure financial health as follows:

Equation (4)

)0.998 X_5 + 0.420 X_4 + 3.107 X_3 + 0.847 X_2 (0.717 X_1 = Z'

Z': total bankruptcy index
X_1: working capital to total assets ratio
X_2: accumulated profit to total assets ratio
X_3: profit before interest and tax to total assets
X_4: book value of company stock to book value of total assets
X_5: sales to total assets ratio

If the calculated total index is less than 1.9, companies face a financial crisis, and when it is more than 1.9, the phenomenon of financial crisis does not threaten them.

Given that the modified Altman model has been accepted in most studies, and citing the coefficients of the Altman model in similar studies such as Cheng et al. (2013), Gomariz and Ballesta (2014), the coefficients of the same model were used in the research.

To operate the above variable, the number 1 was given to companies with financial constraints and the number zero was given to other companies.

The moderator variable in this study is debt maturity. For this purpose, we use the short-term debt ratio to total debt to calculate debt maturity (Huang et al., 2016).

Equation (5) debt maturity = short-term debts / total debts

Control variables

Firm size

The company's size mainly reflects the company's status in terms of profitability, volume of activity, and value. It is calculated through the natural logarithm of the book value of total assets.

Firm size = LN (book value of total assets)

Financial leverage

Represents the company's financial risk and is calculated by the book value of total liabilities to the book value of total assets.

Financial leverage = total debts / total assets

Sales growth

It indicates the company's profitability and is obtained from the ratio of the difference between this year's sales amount and the previous year's sales amount divided by the previous year's sales amount.

Sales growth = (this year's sales – previous year's sales) / previous year's sales

Return on assets rate

It represents the company's performance and is calculated from the net profit ratio to total assets.

Return on assets rate = net profit / total assets

Book value to market value ratio

It is calculated by calculating the book value of equity to market value.

4. Findings

4.1. Descriptive statistics

The obtained findings from descriptive statistics of the research variables are as follows:

Table 2. The statistical description of research variables

Variable	Mean	Median	Max	Min	Std. Dev.	Skewness
Negative skewness of stock returns	0.169	0.167	3.099	-2.348	0.675	0.034
Firm size	14.395	14.170	20.768	10.031	1.663	0.768
Financial Leverage	0.576	0.580	2.077	0.031	0.212	0.501
Sales growth	0.161	0.054	1.000	4.070	0.255	2.213

Asset return rate	0.180	0.125	1.974	-0.605	0.236	2.042
The ratio of book value to market value	0.449	0.387	3.527	-5.668	0.438	-1.164

The average calculated financial leverage is about 57% and shows the high level of liabilities in the companies under study. The average sales growth calculated is about 12, indicating low sales growth in listed companies. The average calculated rate of return on assets is about 31%, which indicates that the average rate of return on assets is below average. Most variables' standard deviation and skewness are calculated to indicate the appropriate and logical data distribution. Examining the amount of skewness and kurtosis of each variable and comparing it with the normal distribution shows that all research variables are normally distributed.

4.2 Testing the first hypothesis

The obtained results from H1 testing are as follows:

Table 3. Findings from the test of the first hypothesis

Variable	Coefficients	Standard deviation	t- Statistics	P-value
Bankruptcy risk	-0.010	0.039	-0.274	0.783
Firm Size	0.024	0.010	2.391	0.016
Financial Leverage	0.035	0.102	0.343	0.731
Sales growth	-0.026	0.063	-0.423	0.672
Asset return rate	-0.079	0.093	-0.852	0.394
The ratio of book value to market value	-0.090	0.039	-2.283	0.022
c	-0.134	0.151	-0.886	0.375
R^2	Adj- R^2	F-test	F-Limmer	Durbin-Watson Test
0.107	0.104	2.255 (0.03)	1.161 (0.086)	2.003

The significance level for each variable and the whole model is calculated at a 95% confidence level. According to the coefficient of determination of the fitted model, it can be claimed that about 10.73% of the dependent variable changes are explained by independent and control variables. As shown in Table 3, the significance level of the test statistic for the bankruptcy risk variable is higher than the acceptable error level of 5%, so the effect of the significance of the bankruptcy risk criterion on the stock price crash risk is rejected, and the first hypothesis is not accepted. The control variables of firm size and book value ratio to market value significantly correlate with the risk criterion of a stock price crash.

Table 4. Findings from the test of the second hypothesis

Variable	Coefficients	Standard deviation	t- Statistics	P-value
Bankruptcy risk	0.131	0.049	2.638	0.008
Debt maturity adjuster variable	-0.006	0.002	-2.933	0.003
Bankruptcy risk × Debt adjustment variable	-0.006	0.002	-2.863	0.004
Firm size	0.031	0.009	3.146	0.001
Financial Leverage	0.377	0.101	3.720	0.000
Sales growth	0.232	0.062	3.700	0.001
Asset return rate	0.123	0.092	1.334	0.182

The ratio of book value to market value	0.030	0.039	0.770	0.441
c	-0.598	0.150	-3.992	0.000
R2 0.136	Adj- R2 0.131	F-test 8.537 (0.000)	F-Limmer 1.172 (0.297)	Durbin-Watson Test 2.011

4.3 Testing the second hypothesis

The obtained results from H2 testing are as follows:

The significance level for each variable and the whole model is calculated at a 95% confidence level. According to the coefficient of determination of the fitted model, it can be claimed that about 13.608% of the dependent variable changes are explained by independent and control variables. As shown in Table 4, the significance level of the test statistic for the bankruptcy risk variable × the moderating variable of debt maturity is greater than the acceptable error level of 5%, so the moderating role of the debt maturity in influencing the significance of the bankruptcy risk criterion on stock price risk is confirmed. The second research is accepted. The control variables of firm size, Financial Leverage, and sales growth significantly correlate with the risk criterion of a stock price crash.

5. Discussion and conclusion

Conceptually, crash risk is based on the argument that managers tend to withhold bad news for an extended period, allowing bad news to stockpile. If managers successfully block the flow of negative information into the stock market, the distribution of stock returns should be asymmetric (Hutton et al., 2009). When the accumulation of bad news passes a threshold, it is revealed to the market immediately, leading to a large negative drop in stock price. Although financial reporting opacity and its effect on crash risk has become the standard research approach, other mechanisms could also generate price crashes. In the Bleck and Liu (2007) model, historical cost financial reporting allows a manager to continue with a poor investment project, thus receiving compensation prior to the project's maturity. This is facilitated because outsiders cannot assess the project's market value until maturity. The Benmelech et al. (2010) model proposes that managers with equity-based contracts continue with negative NPV projects to maximize the value of their compensation packages. Both these models hint towards managerial incentives for hoarding bad news—the precursor for a price crash. Eventually, the manager has to disclose the bad news, causing a large stock price drop. Hong and Stein (2003) developed a model incorporating heterogeneity in investors' beliefs, one of the key drivers of stock price crashes. Investor heterogeneity can potentially reveal the private signals of relatively pessimistic investors. This model begins with the observation that a group of investors (e.g. mutual funds) cannot short-sell stocks. Such constraints inhibit the revelation of negative information known to pessimistic investors about stock prices. However, if other previously optimistic investors exit the market, the former investors may become the marginal buyers. Thus, previously hidden bad news surfaces and results in a price crash. Cao et al. (2002) propose an 'information blockage' model as another theoretical framework for explaining price crash. This model's upward price trend prompts favourably informed investors to engage in active trading. In contrast, less informed traders are naturally sceptical about the true nature of the signals and hence delay trading until the price drops. The price correction is, therefore inevitable when the economic outlook becomes pessimistic and the less informed marginal investors enter the market. Information blockage therefore generates negative returns skewness following price increases but positive skewness following price decreases (Zhu, 2016). Another source of crash risk is volatility feedback effects (Campbell and Hentschel, 1992), whereby 'big price movements could cause investors to reassess market volatility

and increase required risk premia. An increased risk premium reduces equilibrium prices, reinforcing the impact of bad news but offsets the impact of good news, thus generating negative skewness' (Hutton et al., 2009). The default risk-based explanation for crash risk rests on the notion that firms with higher default risks are more likely to release extremely bad news or extremely good news because they will either fail or continue as a going concern. Prior literature used firm size and leverage as proxies for default risk but failed to find support for this proposition. On the contrary, a negative association between leverage and crash risk is documented when leverage should be positively associated with bankruptcy risk (Campbell et al., 2008). One potential explanation for this surprising result may be that high leverage firms are initially underpriced by investors, making it less likely that price crashes will follow. Consistent with this explanation, Campbell et al. (2008) show that high leverage firms generate higher future mean returns than low leverage firms.

Investors and lenders are more inclined to predict the bankruptcy of firms because, in the event of bankruptcy, they will incur high costs. One of the constant concerns of investors is the unfavorable financial situation of the company. Poor financial performance and persistence can lead to the company's bankruptcy. For this reason, financial turmoil will have important adverse consequences, and one of its main effects is investors' fear of the company's future. If the company is in an unfavorable financial situation, it will have consequences such as reducing the credit of the company's managers. Stability in the company's financial situation and lack of turmoil will increase its market value. The risk-based explanation for default risk is based on the argument that companies with higher default risk are more likely to publish extremely bad news or extremely good news because they fail or continue to operate. The previous literature used the size and leverage of the company as representatives of default risk but did not manage to support that. Conversely, a negative correlation between leverage and the crash risk of a fall is proven when the leverage positively correlates with the risk of bankruptcy. A potential explanation for this result is that investors initially undervalue high-leverage companies and are therefore less likely to fall in price. Consistent with this explanation, Campbell et al. (2008) show that companies with high leverage have higher average future returns than companies with low leverage. One of the things that can reduce the likelihood of stock prices is short-term debt. Debt is one of the financial instruments for raising capital. The debt maturity structure mainly influences the company's investment decisions and the investor in debt financing texts. Due to defective debt contracts, creditors may not be able to exercise their right of control over any possible future events under the terms of the contract. However, short-term debt provides better protection for creditors' right to control by threatening not to extend the debt contract, so creditors will demand more control to repay the debt. Due to the right of control granted by short-term debt, lenders can more favorably control the borrowers (the company) and obtain more reliable information about the company's operating performance before re-granting credit. Given that one of the reasons for the sharp decline in stock prices is the accumulation of bad news by managers in line with their interests, creditors are expected to demand the right to control as well as reliable information about the status of the company to lower the risk of losing their claims. In such a case, hiding the bad news is reduced, and the possibility of a sharp drop in stock prices decreases. This study investigates the effect of bankruptcy risk on stock price risk, emphasizing debt maturity in companies listed on the Tehran Stock Exchange. Findings from the test of research hypotheses show that the effect of bankruptcy risk on the stock price crash risk and the role of debt maturity adjustment is not statistically significant and is not confirmed. The results are inconsistent with that of He and Ren (2023) and consistent with Kim et al. (2016).

6. Implications

According to the result, it can be stated that the stock price crash risk as one of the crucial criteria for the continuation of the company should be considered by investors, whether the company is a reliable and stable source to provide the funds needed for favorable investments. And whether the company's net assets are positive and the liquidity of the assets according to the market situation. Despite the lack of significant impact in the general case, the levels of stock price crash risk of companies for investors can influence their decisions in the long or short term. Therefore, it is suggested that stakeholders, especially external investors and creditors, consider companies' stock price crash risk in line with the existence of conditions related to the assumption of continued operation or cessation of activity in their analysis. In line with future research, it is suggested that other bankruptcy criteria, such as Springgate, Falmer, etc., be considered in future research.

Since short-term debts give creditors the right to control in a desirable and ideal way in line with the companies, creditors can access more relevant and reliable information as creditors seek more control rights to lower the risk of loss claims. Therefore, considering the effectiveness of debt maturity criteria, it is suggested that other characteristics of debt such as capacity, structure and type of debt be considered in future research.

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RESEARCH ARTICLE

An Analysis of Scientific Research in the Field of International Financial Reporting Standards: A Scientometric Study

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Abstract

The significance of International Financial Reporting Standards (IFRS) and the interest of a diverse array of global researchers underscore the globalization of financial activities. Despite the substantial volume of publications in this area, the intellectual framework of researchers remains largely unexplored. This research aims to clarify the current state and evolution of this field, highlight the intellectual structure of researchers, and provide new insights for future researchers. The research approach employs scientometrics and data mining. All studies indexed in the Scopus database were analyzed. Word co-occurrence, co-authorship analysis, and Latent Dirichlet Allocation were utilized to create a knowledge map. The co-authorship network analysis by country revealed that the United States, England, Australia, Germany, Italy, Canada, Spain, France, and China exhibited the highest centrality ratings. This research also explored trends and knowledge frontiers over different periods within this scientific domain, which can be categorized into themes such as the acceptance and implementation of IFRS, standard-setting and regulatory frameworks, the quality and transparency of financial reporting, the implications of international standards, corporate governance, and IFRS. The findings provide researchers with a clearer understanding of the existing literature by examining the current state of research in this field. This insight enables them to implement innovative strategies to advance and further develop the scientific discipline. Additionally, researchers can identify potential areas for future studies and interventions by gaining a deeper understanding of the concepts and methodologies within this field.

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1. Introduction

Accounting, as an information system, relies on the processing and analysis of financial information. Any analytical system must be grounded in a coherent set of principles and rules. Accounting principles are primarily derived from agreements, rules, and procedures that have gained acceptance among most accountants and professional accounting bodies. Over the past two decades, international accounting has undergone a dynamic transformation due to economic globalization, technological advancements, and the increasing complexity of cross-border financial transactions. This transformation has led to developing more conceptually advanced and practically useful accounting and financial reporting standards for multinational companies. The demand for the convergence of international accounting standards is growing stronger, prompting efforts to integrate national accounting systems with international standards (Judijanto et al., 2023). Accounting standards are based on the fundamental principles and concepts of accounting, and their practical applications can be observed in these standards. They also guide professionals, providing a framework and guidelines for addressing challenges. In this context, international accounting is significant for several reasons. First, it enables companies to operate in multiple countries without the burden of navigating differing accounting regulations. It also assists companies in complying with standards, which can enhance their reputation and credibility in global markets. Furthermore, it provides standardized financial information that facilitates the comparison of companies from different nations. Thus, international accounting is essential for the effective functioning of organizations in a globalized economy (De Luca et al., 2024). In general, standards reflect the professional community's commitment to maintaining coordinated and high-quality practices (Bowrin, 2007). The synchronization of international standards in the global economy appears to be crucial. Theoretically, a consensus is that a unified set of high-quality standards protects investors' interests and reduces the costs associated with accessing capital markets worldwide. Accounting is a common language, and the increasing globalization of financial activities necessitates using this shared language. IFRS represents, in essence, the globalization of financial activities, while international harmonization influences corporate governance, auditing, ethical standards, and supervisory mechanisms.

Since the establishment of IFRS, a diverse array of countries worldwide have adopted and implemented these standards. In 2002, the European Union (EU) mandated that entities listed within the EU, including banks and insurance companies, prepare their consolidated financial statements by IFRS approved by the EU, starting in 2005 onwards (Eu, 2002). The acceptance of IFRS at both national and supranational levels was subsequently endorsed by most accounting jurisdictions globally. According to a recent report from the IFRS Foundation, as of 2018, 144 jurisdictions, or 87% of the total worldwide, require IFRS for all or most companies. The International Accounting Standards Board (IASB) reported in 2019 that the international accounting landscape has recently experienced a remarkable trend toward adopting IFRS at the national level, as issued by the IASB. Currently, 168 countries apply for the IFRS (IFRS, 2023). This organization indicates that 145 countries utilize IFRS for nearly all companies listed on stock exchanges, while 13 countries permit use. The organization also provides an analysis of the commitment to IFRS, highlighting the degree of adoption based on specific criteria (Quiñónez et al., 2024):

- Mandatory implementation of IFRS for national public companies.
- Required and Permissive Status for National Public Companies.
- Status of requirements and permissibility for the listing of foreign companies
- Required and permissive status for micro, small, and medium-sized enterprises (SMEs)
- Consideration for SMEs

The purposes of IFRS are multiple (Nguyen et al. 2023); the most significant objectives in the financial realm include establishing a common framework, providing technical assistance to users, supporting the categorization of data reporting, offering a foundation for the preparation of reliable financial records, and ensuring the comparability, transparency, and flexibility of such reports. Implementing these standards can enhance a company's appeal in the financial sector by providing insights into competitors and enabling potential investors to understand the company's information and growth opportunities. According to The IFRS Foundation (2018), IFRS outlines how reports should be prepared and defines the primary objectives of each report. Consequently, the standards encompass the following statements: the equity position (or balance sheet), the results (or profit and loss account), changes in equity, the statement of comprehensive income, and cash flow statements, along with explanatory notes for these statements. Additionally, IFRS specifies the elements that must be included and categorized into five equity categories: assets, liabilities, equity, income, and expenses. IFRS incorporates guidelines designed to establish a uniform approach to preparing financial statements. Among these are (Quiñónez et al., 2024):

- How they should be presented, including the balance sheet, income statement, statement of changes in equity, statement of comprehensive income, and statement of cash flows.
- Description of how assets and liabilities should be measured, including initial measurement, subsequent measurement, and depreciation.
- Accounting for income and expenses.
- Disclosures, including accounting policies and information about financial instruments.
- Standards applicable to specific sectors: IFRS also includes standards that apply to specific sectors, such as financial institutions, insurance companies, and mining companies.

The International Organization of Securities Commissions, a proponent of investor interests, regards IFRS as a high-quality and appropriate framework for addressing investors' informational needs (De George and Shivakumar, 2016). These standards encompass a comprehensive set of accounting principles developed by the International Accounting Standards Board (IASB) for preparing financial statements by public companies and establishing a global benchmark. By adopting IFRS, companies can consistently present their financial statements with those of their competitors. IFRS plays a crucial role in the pursuit of harmonization, as one of its primary functions is to promote the alignment of accounting standards worldwide, ensuring they are comprehensible and compliant with established accounting principles (De Luca et al., 2024). The emergence of discrepancies among the standards of various global markets prompted the development of these standards, which standardize accounting language and facilitate business transactions between corporations. The adoption of IFRS enables the comparison of financial information across companies and fosters the establishment of a unified accounting language for organizations with multiple branches.

The harmonization of national accounting systems across different countries with IFRS is one of the most fundamental processes in international accounting and has held significant importance in accounting research for many years. This harmonization process enhances the comparability of financial statements among countries, making them more useful for investors and other stakeholders (Piechocka-Kaluzna, 2021). Research has also examined the impact of country-level financial integration on firms' accounting choices and the quality of financial information, revealing a positive association between financial integration and earnings management (Shah and Wan, 2024). The adoption of these standards leads to improved quality in financial reporting, greater comparability of financial statements, enhanced information transparency (Do et al., 2019), reduced informational asymmetry, and the provision of more tangible and informative content (Cordazzo

and Rossi, 2020). The implementation of IFRS has been identified as a key factor in enhancing public sector performance, attracting foreign investments, and contributing to economic development (Nugrahanti, 2023). Once organizations adopt these standards, their accounting and financial documentation become reliable in other countries. Consequently, those seeking international investors or aiming to be listed on the stock exchange must invest in international accounting practices (Al-refiay et al., 2023). A strong market position adds value and fosters organic business growth. Opportunities arise from the credibility that a corporation establishes by publishing its financial data securely and transparently. Furthermore, this credibility enhances the significance and security of stakeholder relationships, promoting a practical, coherent, and legally substantiated engagement with the organization (Rosmianingrum et al., 2023). Ultimately, this leads to improved stock price predictions based on the equity and earnings book value (Jermakowicz et al., 2018). According to Oyewo (2020), a critical feature of this process is the extent of fair value accounting or market value accounting adoption. Countries willing to adopt IFRS can do so through two methods: the Direct Method and the Indirect Method. The Direct Method, also known as adoption, involves implementing IFRS as they are within a specific jurisdiction. Adoption means that IFRS serve as the primary GAAP by domestically listed and unlisted companies in their consolidated financial statements for external reporting. This indicates that the presentation notes and the auditor's report confirm that the financial statements are prepared in accordance with IFRS. In contrast, the Indirect Method, or convergence, involves implementing IFRS with certain informed divergences. Convergence aims to achieve harmony with IFRS while allowing for the design and maintenance of national standards, ensuring that financial statements are prepared according to national accounting standards, including an unequivocal statement of compliance with IFRS. However, convergence is a transitional strategy that may facilitate adoption over time but does not replace the need for full adoption. Regardless of the various pathways to IFRS, the ultimate goal should be the full adoption of IFRS Standards as issued by the International Accounting Standards Board (IASB). Convergence refers to aligning local standards with international standards, aiming to fully adopt the requirements of the international standards (Bathla et al., 2023).

De Moura and Gupta (2019) argue that obtaining better information is a crucial rationale for implementing IFRS. The adoption of these standards ensures that financial statement items are measured and identified according to economic realities. It also facilitates the provision of a set of information in explanatory notes. According to Stakeholder Theory, Ball et al. (2000) assert that financial statements prepared in accordance with IFRS can provide high-quality accounting information to support investors. Hallberg and Persson (2012), applying Spence's (1978) signaling theory, posit that companies signal to market participants their commitment to more transparent financial reporting through the adoption of IFRS. Reese Jr and Weisbach (2002) contend that the adoption of IFRS can reduce information asymmetry costs. IFRS enhances the comparability and transparency of financial information for investors, thereby encouraging cross-border investment (Lepone and Wong, 2018). This phenomenon is further driven by globalization, which fosters alliances between different nations and creates new business practices. Quiñónez et al. (2024) state that this action has significantly impacted the economic-administrative areas, specifically the accounting area. Thus, accounting is included in the globalization of the world economy, especially in the collection of international funds and the reduction of trade barriers between nations. As a result, accounting information becomes a critical factor in investment decisions. Mora and Walker (2015) suggest that the adoption of standards can lower capital costs for companies, reduce risks for investors, eliminate confusion arising from diverse accounting methods, and facilitate efficient resource allocation, ultimately leading to economic growth. IFRS enhances investors' ability to

make informed financial decisions and assess financial status and performance across different countries (Do et al., 2019). According to Mensah (2021), the cost of information for investors decreases, fostering greater motivation for international investment and appropriate resource allocation. IFRS is shareholder-oriented and is generally perceived as a model of fair value accounting that enhances disclosure and improves the understanding of financial statements (Kainth and Wahlstrom, 2021). The implementation of IFRS may impact various aspects of companies beyond financial statements and reporting, influencing all dimensions affected by financial data and information, such as financial evaluation criteria, employee reward schemes, internal management reports, investor relations, and market value analysis. The KPMG Audit Institute believes that the IFRS implementation process affects companies in four dimensions: accounting and reporting, systems and processes, business, and people (Bhargava and Shikha, 2013). Findings indicate that implementing IFRS can potentially improve client-auditor relationships, thereby enhancing audit quality by facilitating the timely generation of audited statements (Lee and Choi, 2024).

As companies worldwide seek to raise capital in foreign countries, the financial statements of multinational business units must be comprehensible to foreign investors to enhance capital effectiveness. The adoption of a unified set of IFRS for these multinational entities presents an opportunity for the acceptance of securities not only across various global stock exchanges but also facilitates broader financial activities, addressing the potential needs of creditors and investors, regardless of their place of residence (Morales and Zamora-Ramírez, 2018). Following the implementation of fixed asset valuation in Spanish and British companies, there has been an increase in total assets, non-current liabilities, current liabilities, operating income, and net income. However, current assets and total equity value have decreased (Gastón et al., 2010). In Canadian companies that have adopted IFRS, the value of deferred taxes, minority interests, employee benefits, fixed assets, liquidity, and real estate investments has experienced significant changes, depending on the industry (Jermakowicz et al., 2018). In Turkish companies, implementing IFRS has not resulted in substantial differences in the values of total assets, properties, machinery, and equipment; however, net income and asset returns have increased (Karapınar and Zaif, 2022). Similarly, in French companies, after adopting IFRS, total assets, total liabilities, total revenues, and expenses have risen, while total equity has decreased (Ozturk, 2022).

The topic of IFRS has garnered significant attention from the academic community, leading to the exploration of various dimensions of this phenomenon. This discussion has been the focus of numerous research studies conducted globally. For instance, researchers have examined the impact of adopting IFRS on investors (Nnadi, 2015), compliance with regulations and auditing practices (Chen and Zhang, 2010), and the cultural and institutional consequences of these standards (Cieslewicz, 2014). Additionally, studies have investigated influential and specific factors affecting standards adoption from a national and country-specific perspective (Hassan, 2008; Judge et al., 2010; Nobes and Zeff, 2016), the utility of implementing these standards to attract foreign investment, and the relationship between adoption and the enhancement of accounting quality, particularly in European Union countries (Van Tendeloo and Vanstraelen, 2005). Some studies indicate a positive correlation between IFRS adoption and accounting quality (Chua et al., 2012), while others suggest that acceptance may be associated with a decline in accounting quality (Paananen and Lin, 2009). This field of study has also been approached through literature reviews. For example, Kuo et al. (2011) examined the landscape of accounting standards research, providing a unique map to better understand publications related to accounting standards. Their study offered a systematic and objective mapping of various themes and concepts in the development of the accounting standards field. The authors aimed to identify the connections among different

publications and confirm their contributions to the evolution of accounting standards. They investigated the intellectual foundations of accounting standards research using bibliometric and social network analysis techniques. The study concluded that contemporary research in this area is organized around several key concentrations of interest, including earnings and returns, IFRS, investment, management behavior, and modern accounting practices. The mapping of the intellectual structure of accounting standards indicates that this field has developed its own literature and established itself as a legitimate academic discipline. Lourenco et al. (2015) aimed to characterize the results of scientific research on the effects of adopting IFRS published in the most prestigious scientific journals in the accounting field from 2000 to 2013. The authors utilized journals in the Social Sciences Citation Index (SSCI), a database developed by the multinational news agency Thomson Reuters. Their analysis focused on 67 articles published in accounting journals that are part of the SSCI. The findings revealed that IFRS adoption positively impacts information quality, capital markets, analysts' predictive abilities, comparability, and information utilization. However, the effect is contingent upon various factors, such as a country's characteristics (notably, the level of enforcement) and the characteristics of companies. Merely sharing rules is insufficient to establish a common business language; management incentives and institutional factors play a significant role in shaping the characteristics of financial reporting. De George and Shivakumar (2016) investigated how the adoption of IFRS affected financial reporting quality, capital markets, corporate decision-making, supervision and governance, debt contracts, and auditing practices. Bengtsson (2021) sought to identify the factors influencing the complete, partial, or non-adoption of IFRS in different countries. The results indicated that while a wide range of determining factors influences national adoption of IFRS, three main categories of determinants emerged: 1. Social-legal traditions, including legal systems, education, and culture; 2. Economic and financial needs, such as access to foreign capital, open economies, economic growth, and the presence of financial markets; 3. Organizational dynamics encompassing lender-borrower relationships and the international organization's membership network of national accounting standard setters. Nguyen and Nguyen (2023) identified factors influencing the voluntary adoption of IFRS through an analysis of international empirical studies. Factors such as company operations, capital structure, ownership structure, internationalization, financial performance, and corporate governance play significant roles. Ezenwoke and Tion (2020) conducted a bibliometric study to explore the adoption of IFRS in Africa. The statistical population of this research included only 73 published studies from the continent. The results indicated that the first study was indexed in the Scopus database in 2005, revealing an increasing trend in publications and citations and identifying dominant subject areas such as management and accounting, economics, financial affairs, and social sciences. Judijanto et al. (2023) examined highly cited publications in international accounting, revealing six distinct clusters that highlight key themes, including challenges in the accounting profession, financial accounting practices, cultural influences, governance dynamics, and value relevance. Quiñónez et al. (2024) examined the implementation of IFRS in Latin America. The analysis indicated that adopting IFRS in the 18 countries studied was driven by aligning with global accounting practices and facilitating transparent financial reporting. The results suggested that while each country has its own accounting methods, adopting these standards prompts a convergence process and influences accounting procedures. In the studies conducted through literature review and bibliometrics, several limitations were observed, including constraints in the search strategy, a lack of clear visual representation of global studies in this field, insufficient transparency in the searched databases, a narrow focus in some studies, and a limited range of publication years. Additionally, some articles analyzed were not sourced from high-impact factor journals. In light of these facts, these review studies do not afford a full picture of the state-of-the-art research on IFRS.

A study offering a complete understanding of the IFRS literature is still missing. To fill this gap, the present review study is the first to review the intellectual core and landscape of the general body of knowledge on IFRS using quantitative techniques. In other words, since a comprehensive study employing bibliometric and scientometric approaches has not been conducted from the inception of this publication to 2023, the present research aims to address these limitations by covering a wide range of retrieved studies, utilizing a broader spectrum of related keywords, and conducting searches in the largest scientific databases to expand the scope of the study. This research also aims to reduce subjective bias by applying scientometrics, providing a tangible and global perspective on this concept's development and future directions. This study contributes to the field in several ways by identifying the scope of the existing body of knowledge, detecting omissions and deficiencies, integrating scientometric analysis in the research topic by using VOSviewer, Python, and synthesis tools to provide an effective framework for understanding IFRS; categorizing the diverse set of documents related to the review of IFRS; introducing further research opportunities through the use of scientific maps and thematic cluster reviews, which facilitate the identification of emerging themes from both empirical and theoretical literature; contributing to designing larger and more in-depth studies in the field of IFRS; and determining where best to focus future research efforts.The significance of IFRS research extends beyond academic inquiry and has practical implications for financial professionals, policymakers, and businesses operating in a global environment. Bibliometric analysis offers a systematic and quantitative approach to evaluating the advancement of knowledge. It provides insights into the evolution of research topics and the collaborative networks that foster innovation within the field. It can help these stakeholders make vital contributions to developing and accruing intellectual wealth to the IFRS area while providing them with a detailed understanding of the trend and status quo of the IFRS publications.

As previously mentioned, despite the growing interest in the discussion of IFRS, only a limited number of studies have focused on measuring and analyzing scientific publications globally. This topic appears to be an emerging research area with significant potential for more in-depth studies to enhance familiarity and improve the global community's understanding of this phenomenon. Through further research, particularly employing literature review methods, we can gain deeper insights into this concept's importance, methodologies, and various approaches and potential opportunities. Increased attention to this area may facilitate the global harmonization of these standards within accounting and financial systems. While attempting to explore various aspects of this concept, previous studies have not conducted a comprehensive bibliometric and scientometric analysis due to the rapid growth of publications in this field. The current research aims to enhance understanding of this area by conducting a scientometric review of relevant publications and visualizing the findings. This study seeks to broaden and deepen research in this domain by visualizing the literature and delineating the boundaries of knowledge over different time intervals. The primary objective of this research is to examine the temporal distribution patterns of literature on IFRS in international studies, represent the collaborations and contributions of researchers, leading countries, and top educational institutions, and provide insights for future research directions in this field. One of the key reasons for the significance of this research is its potential to mitigate the author's cognitive bias. Despite the high volume of publications and their wide-ranging topics, there remains a gap in understanding how researchers in this field have structured their concepts. This research investigates the evolutionary trends of scientific knowledge on IFRS to identify the most influential researchers, institutions, research centers, and emerging trends. To achieve this, the research questions are formulated as follows:

How is the temporal growth of publications related to IFRS?

Who are the key players and influential contributors in this field?

What are the most frequently occurring keywords related to IFRS, and how do these keywords co-occur within this field?

How has the knowledge boundary evolved in this field?

2. Methodology

The current research is an applied study using common scientometrics and data mining techniques. These methods have expanded across various scientific domains (Morales-Munoz et al., 2020). Researchers employ these techniques for several purposes, including discovering the intellectual structure of a specific field, visualizing patterns of research collaboration, identifying emerging trends in knowledge, and recognizing subtle evolutionary differences within scientific domains, all while managing a large volume of data. This approach also aids in generating research ideas and identifying gaps in the literature (Donthu et al., 2021). The present study focuses on bibliometric analysis, co-occurrence of terms, co-authorship analysis, and social network analysis to create a knowledge map and analyze research collaboration networks and thematic clusters in the IFRS field. The research population comprises all internationally indexed articles in Scopus, a comprehensive and reliable scientific database covering a wide range of scientific fields. Consequently, it encompasses a broad spectrum of literature related to IFRS. By accessing bibliographic data and utilizing visualization software, a form of literature review known as scientometrics and bibliometrics can be performed, which visualizes scientific knowledge and outlines the intellectual structure of the field. Studies employing this approach typically involve data mining, focusing on research articles' titles, abstracts, and keywords. For the current research, a search in the Scopus database in early December 2023 retrieved 2,910 records. After this initial retrieval, the documents were saved in an Excel file for refinement. Some studies were excluded for irrelevance, lack of subject relevance, absence of an abstract, and duplication, resulting in 2,432 articles available for analysis. Visualization and data analysis were conducted using VOSviewer, UCINET, and NETDRAW software. VOSviewer was utilized to create a knowledge map, categorize thematic clusters, outline the knowledge boundaries, and identify the main research topics through a co-occurrence approach to keywords. This method is based on the premise that terms that frequently co-occur in a body of text are semantically related. In other words, the more two terms co-occur in texts, the more similar they are in meaning (Guns et al., 2011). The outputs from VOSviewer consist of items, lines, and colors, with items of higher weight appearing more prominently. Items are represented as labeled circles, with their weight determining the size of both the circle and the label. Different colors distinguish clusters while connecting lines indicate links between items. UCINET software was utilized to transform the data into a format suitable for entry into NETDRAW and to create a collaboration network map of authors and countries. Following these steps, social network analysis was conducted to describe the collaboration network among countries and the co-authorship network of researchers. Both macro-level and micro-level network indices were employed to analyze these networks. Macro-level indices focus on the overall topology of the network to understand its general structure. In contrast, micro-level indices evaluate the key actors within the network to assess the characteristics and status of each participant. The calculated indices in this research include density, clustering coefficient, and centrality. Density measures the relationships that connect nodes in the network and helps prevent fragmentation. It indicates the direct connections between entities and is expressed as a value between zero and one. A value close to one signifies a cohesive network with a higher density of connections, while a lower value occurs when the number of links is less than the number of nodes (Soheili and Osareh, 2014). The clustering coefficient reflects the tendency of researchers to form co-authorship clusters. Centrality, determined by counting the number of adjacent nodes to a given node, indicates the

extent of author collaborations with other individuals in the network and their role as intermediaries between nodes (Borgatti and Everett, 2006). This research is also data-driven, employing data mining methods to extract new, valid, and practical knowledge from a large volume of scattered data. The Latent Dirichlet Allocation (LDA), a classic topic modeling method, was used to explicitly construct research topics for bibliometric and scientometric purposes. The search strategy and research process are illustrated in Figure (1).

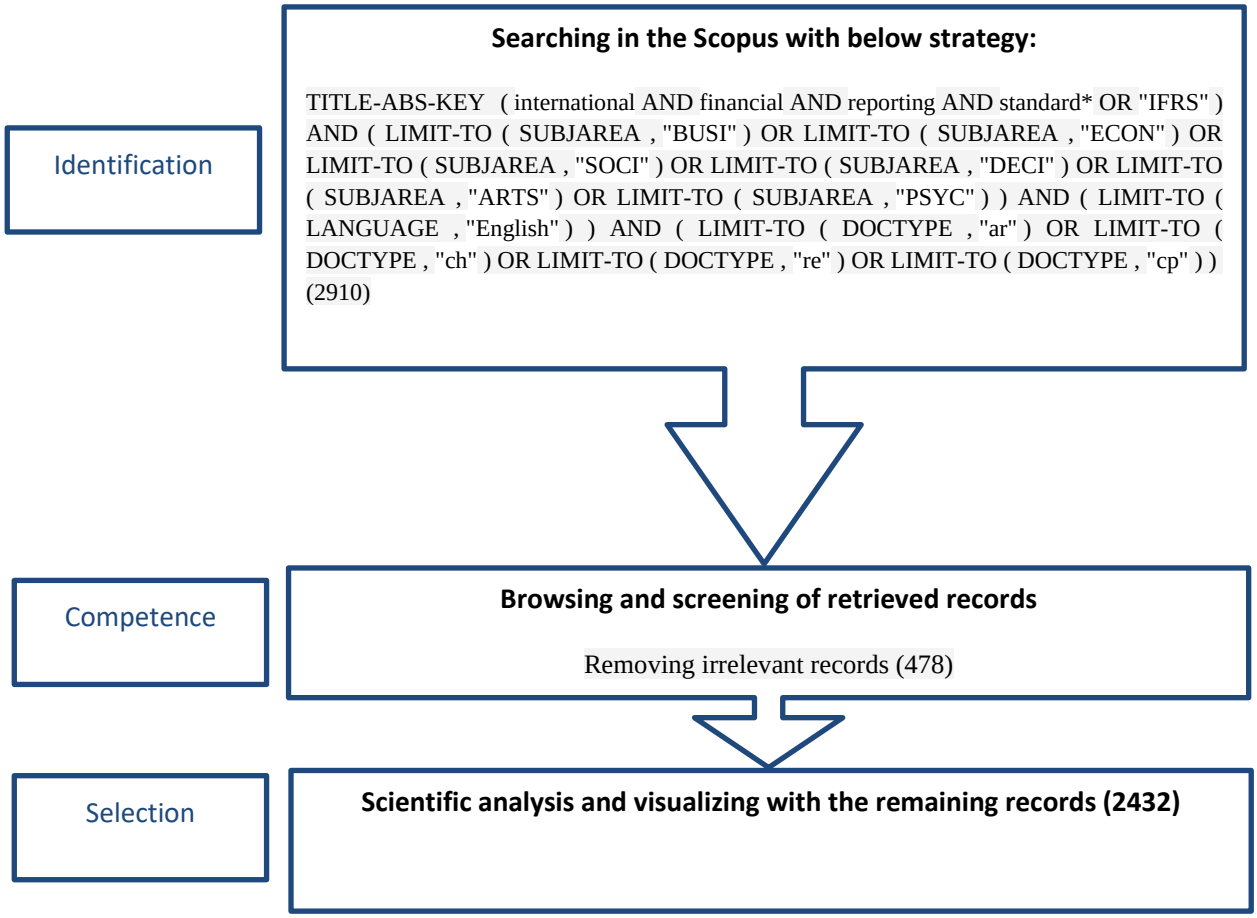


Figure 1. Search strategy and research implementation process

3. Findings

3.1. Research growth trends in the area of IFRS

Figure (2) illustrates the publication status in the field of IFRS, which began with the writing of an article in the 1980s and has continued to the present, December 2023, resulting in a total of 235 published articles. According to the Figure, research growth in this area was slow from the emergence of the concept until 2010; however, from that year onward, the publication growth rate has significantly increased. Overall, the trend in the growth of publications in this field demonstrates a consistent upward trajectory.

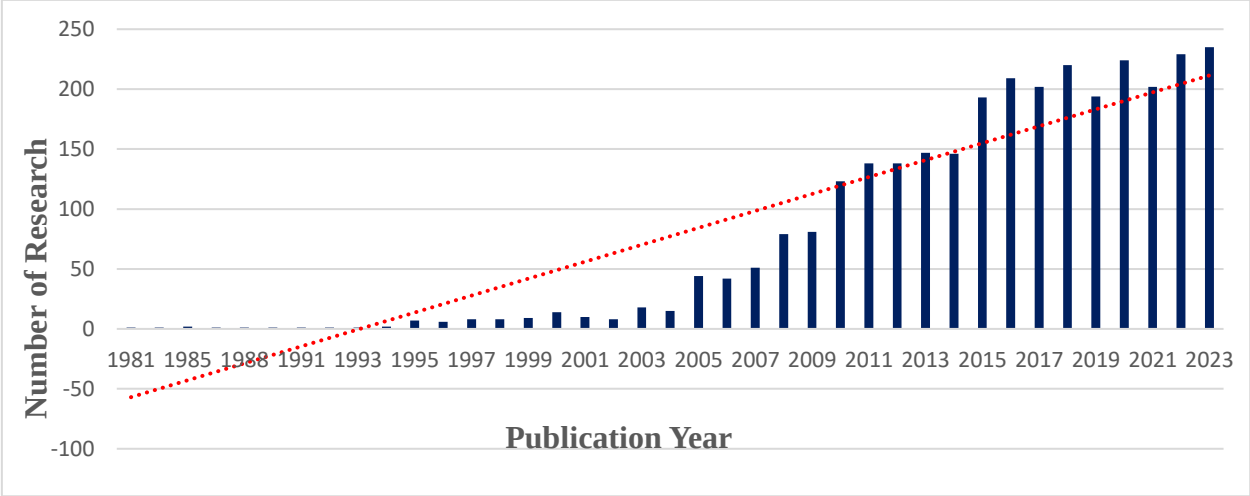


Figure 2. Research growth trends in the area of IFRS

3.2. Publications in the field of IFRS by document type

Table (1) presents the number of publications on IFRS categorized by document type. The predominant form of articles in this subject area is original research articles. Other higher-frequency document types include conference papers, book chapters, review articles, books, and notes. Additionally, there are documents such as datasets; however, this type of document has not yet gained significant traction among researchers in this field. It is important to note that articles of this nature typically include relevant research data as supplementary materials. In contemporary publishing, a substantial number of journals and publishers recognize the importance of research data—particularly concerning research credibility and reproducibility—and therefore request and publish research data from authors. Furthermore, it is noteworthy that these datasets also have the potential to be cited.

Table 1. Publications in the field of IFRS by document type

Type	Number of publications	Percentage
Article	2922	79.300%
Conference Paper	243	6.600%
Book Chapter	216	5.800%
Review	187	5.000%
Book	54	1.400%
Note	28	0.700%
Short survey	8	0.002%
Editorial	7	0.001%
Conference Review	6	0.001%
Letter	5	0.001%
Erratum	3	< 0.001%
Retracted	1	< 0.001%
Dataset	1	< 0.001%

3.3. Leading Journals

Today, the vast number of journals across various subject areas makes identifying influential and core journals within each discipline essential. Figure (3) illustrates the most prominent journals for publishing scientific findings related to IFRS. In this figure, the size of the circles represents the journals' influence in the field, highlighting their crucial role as central nodes in disseminating

theoretical and empirical articles that contribute to advancing knowledge on IFRS. The leading journal is "Accounting in Europe", followed by the Australian Accounting Review. Journals in this domain primarily focus on accounting and finance. Table (2) provides details of journals that have published over 50 articles and received over 100 citations. Major publishers of these journals include Wiley, Elsevier, Taylor & Francis, Springer, Emerald, Sage, and Oxford University Press.

Figure 3. Leading journals

Table 2. Leading journals

Journals' Title	Published Articles
Accounting In Europe	126
Australian Accounting Review	103
Journal Of International Accounting, Auditing & Taxation	97
International Journal of Accounting	96
Accounting & Business Research	71
Journal OF International Accounting Research	66
Journal Of Applied Accounting Research	60
Accounting & Finance	59
Advances In Accounting	57
European Accounting Review	56
Journal OF Financial Reporting & Accounting	56
Journal Of Accounting & Public Policy	53
Academy Of Accounting & Financial Studies Journal	52
International Journal of Accounting, Auditing & Performance Evaluation	50

3.4. Leading countries in IFRS research

In Figure (4), the visualization created by VOSviewer software illustrates the distribution of publications by country. The closer the countries are to each other, the stronger their collaborative relationship, indicating a higher level of cooperation. This map includes countries with more than twenty published articles, totaling 44 countries. Among these, the United States leads with the highest number of publications in this field, followed by the United Kingdom, Australia, Germany, Italy, Canada, Spain, France, and China. The advantages of international collaboration extend

beyond networking; they also encompass knowledge exchange, access to diverse expertise, the expansion of scientific communication, and heightened international awareness, all of which contribute to broadening research horizons.

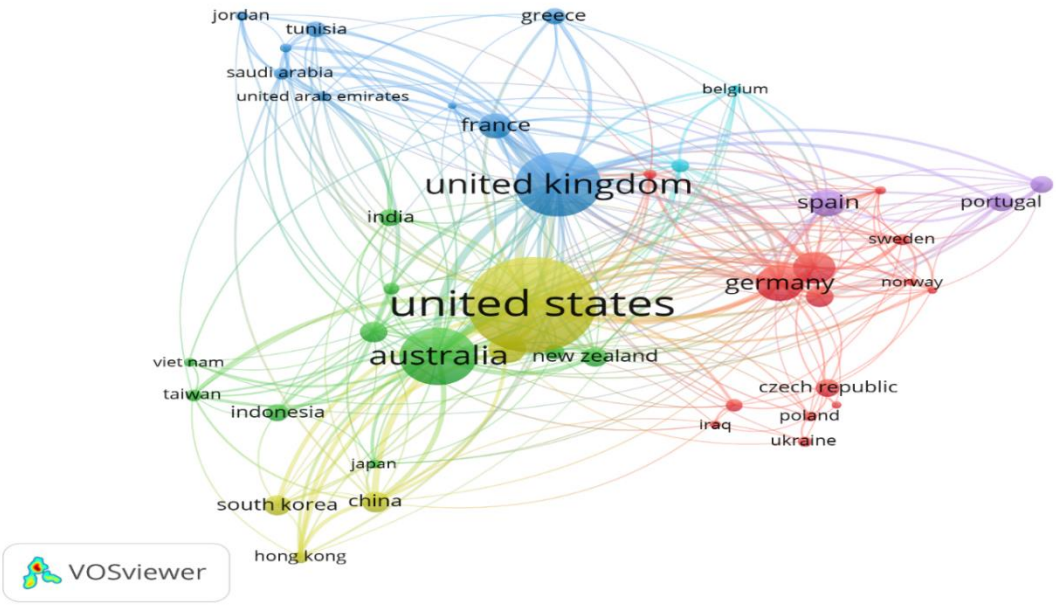


Figure 4. Leading countries in IFRS research

3.5. Top universities in IFRS research

Figure (5) illustrates the leading institutions and universities researching IFRS. The figure indicates that this field of study has garnered increased attention in universities in the United States and Australia. Notably, three universities—Macquarie University in Australia and the State Universities of California and Arizona in the United States—have produced the highest number of research publications.

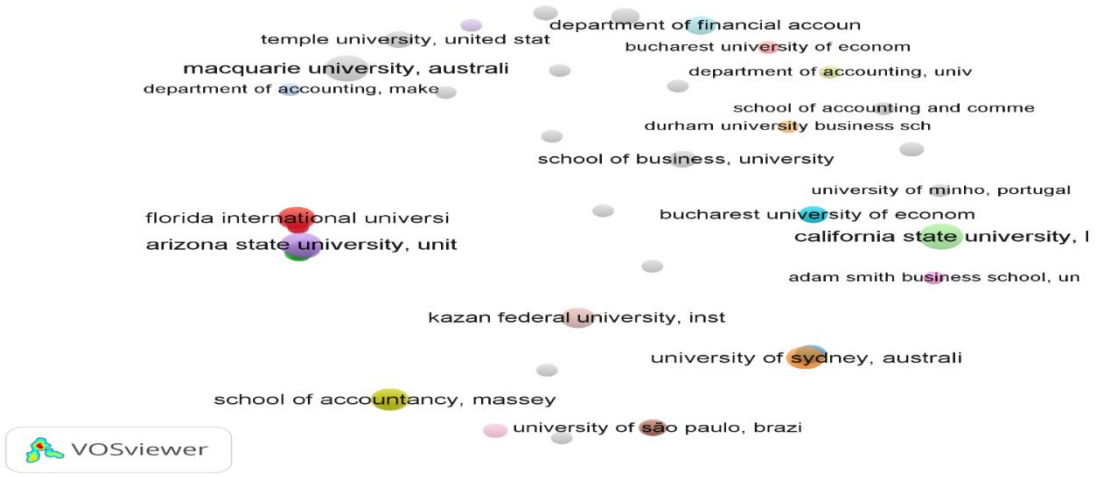


Figure 5. Top universities in IFRS research

3.6. Co-authorship network of researchers in the field of IFRS

Collaborative research participation and cooperation among researchers are essential to scientific communication. This study employed social network analysis to examine the co-authorship network of researchers, utilizing macro-level indicators (density and clustering coefficient) and micro-level indicators (degree centrality). The results revealed the involvement of 4,269 authors in research publications within this field. According to Figure (6), 71 authors were identified as having published a minimum of four articles. The density index calculation for constructing the co-authorship map in this field indicated that the network lacks high density or compactness, with only 0.052 of all potential links formed. In other words, only a small fraction of possible communications have been established within this network, and the relationships between nodes have not fully developed. The calculation of the clustering coefficient, which reflects researchers' propensity to form co-authorship clusters, yielded a value of 0.935. This suggests a relative tendency among network members to create various clusters. One indicator of researchers' influence in their specialized field is their collaboration and participation with other researchers. In a co-authorship network, the degree centrality of a node represents the total number of co-authorships a researcher has with others. The more connections a researcher establishes, the higher their rank in terms of degree centrality compared to their peers. The calculation of this index for researchers in this field indicated that Tarca Ann, with a degree centrality of 0.029, has the highest number of co-authorships. Following her, Luzi Hail, Lee Edward, Christian Leuz, and Martin Walker, each with a degree centrality of 0.018, are ranked second. Members with a high degree of centrality are recognized as active participants in the network and demonstrate significant collaboration. Additionally, a significant number of authors in this field are isolated, meaning they conducted research in this area without engaging with the broader network. Table (3) shows feature authors with high centrality degrees.

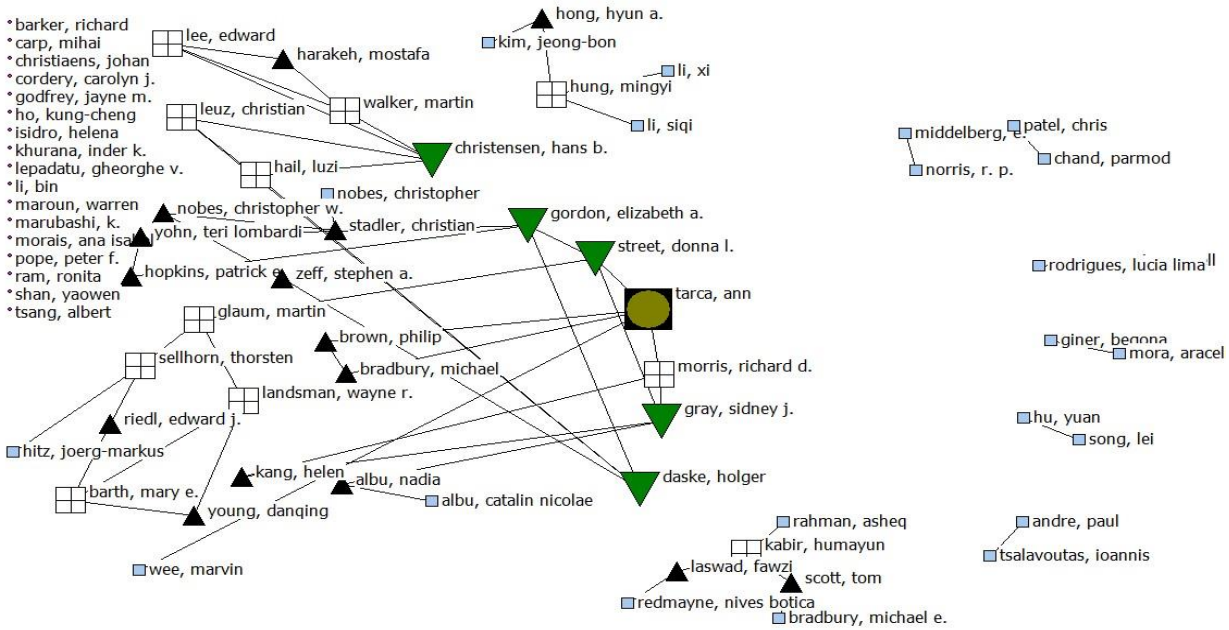


Figure 6. Co-authorship Network of Researchers in the Field of IFRS

Table 3. The centrality of the top researchers in IFRS

Author's Name	Degree Centrality
Tarca, Ann	0.029
Hail, Luzi	0.018
Lee, Edward	0.018
Leuz, Christian	0.018
Walker, Martin	0.018
Brown, Phillip	0.016
Christensen, Hans B.	0.014
Daske, Holger	0.014
Albu, Nadia	0.012

3.7. The most common keywords in the field of IFRS

The total number of keywords related to IFRS research is 7,699. By establishing a threshold of 10—indicating that keywords must appear at least 10 times in articles within this field—267 keywords were identified. Figure (7) and Table (4) present a list of the most frequently occurring keywords in this area, along with their respective frequencies. Notable keywords include "IFRS" (1,358 occurrences), "financial reporting" (288), "earnings management" (182), "adoption of standards" (176), "accounting standards" (163), and "corporate governance" (159). This suggests that the literature on IFRS is strongly connected to financial reporting, earnings management, adoption of standards, accounting standards, and corporate governance.

Table 4. Frequency of Common Keywords in IFRS Articles

Rank	Keyword	Occurrences	Rank	Keyword	Occurrences
1	International financial reporting standards	1358	16	convergence	64
2	Financial reporting	288	17	regulation	62
3	Earning management	182	18	Information asymmetry	60
4	IFRS adoption	176	19	Financial statements	58
5	Accounting standards	163	20	goodwill	56
6	Corporate governance	159	21	comparability	56
7	Accounting	149	22	harmonization	55
8	Fair value	140	23	Intangible assets	53
9	Disclosure	106	24	compliance	51
10	Ifrs9	86	25	Fair value accounting	51
11	IASB	85	26	Accounting regulation	49
12	International accounting standards	76	27	Conceptual framework	47
13	Accounting quality	73	28	Financial reporting quality	46
14	Earning quality	73	29	Financial instruments	46
15	International Accounting	66	30	Audit quality	46

3.8. Distribution of keywords in IFRS based on the Co-Occurrence rate of words

This section illustrates another representation of the conceptual network within this scientific field using keyword co-occurrence analysis. By counting the frequency of each thematic term and its co-occurrence with other terms, we can infer that if two terms appear together more frequently in a document, there is a stronger semantic relationship between them. Table (5) displays the co-occurrence of terms in this field, highlighting pairs of keywords with the highest frequency in the research area. The most frequent co-occurrences, in addition to the primary topic of IFRS, include the following: "management of earnings" with "IFRS" (26 co-occurrences), "IFRS" with "Accounting Standards" (24 co-occurrences), "accounting standards" with "regulations" (23 co-

occurrences), “disclosure” with “IFRS” (19 co-occurrences), “IFRS” with “corporate governance” (12 co-occurrences), “IFRS” with “accounting quality” (12 co-occurrences), “value relevance” with “IFRS” (10 co-occurrences), and “corporate social responsibility” with “sustainable reporting” (10 co-occurrences).

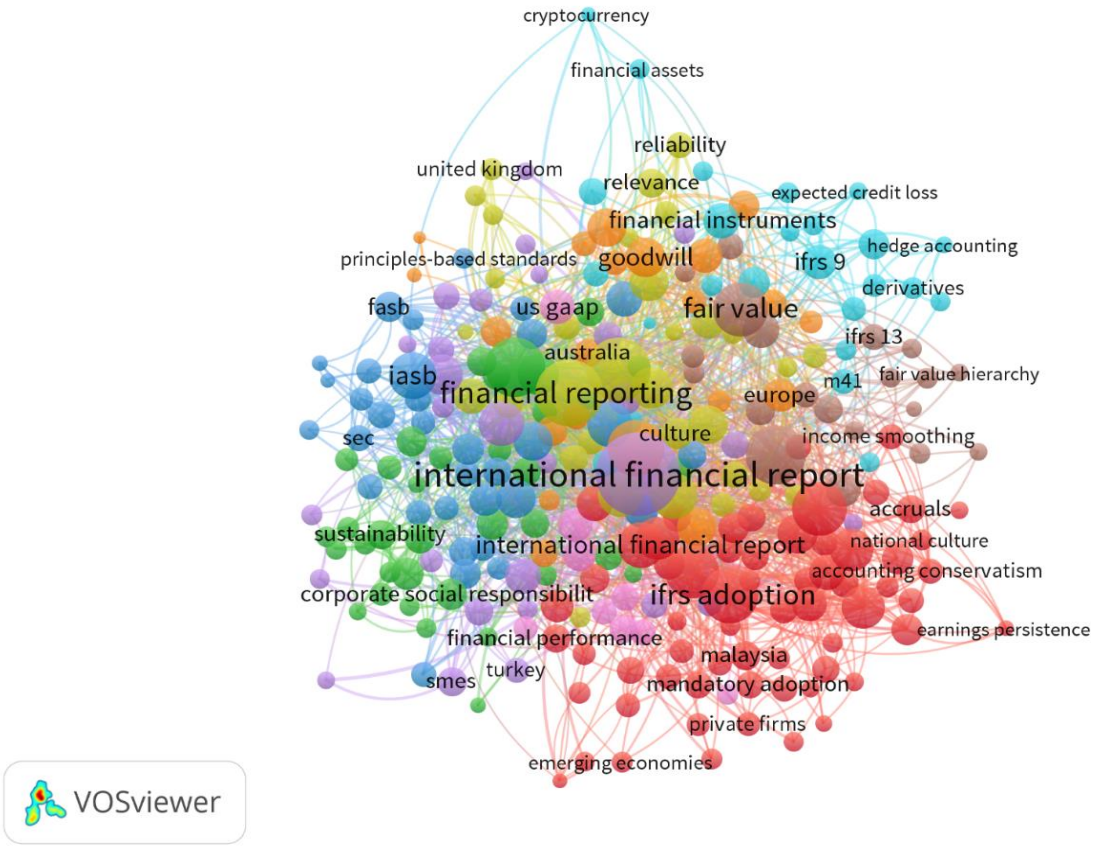


Figure 7. Frequency of Commonly Used Keywords in IFRS Articles

3.9. Topic modeling using latent Dirichlet allocation (LDA)

In this research, topic modeling was performed using the Latent Dirichlet Allocation (LDA) algorithm and creating a word cloud. Figure (8) presents ten proposed topics derived from these operations. The algorithm was applied to the words and keywords found in the abstracts of the articles. The necessary steps for these operations include preprocessing the abstracts, removing punctuation marks, converting all letters to lowercase, standardizing different forms of words into a unified term, and eliminating stop words. Relevant terms are displayed in the right column, with the term “financial” having the highest frequency. Following that, the term “accounting” is present. Other notable terms include “IFRS”, “Standards”, “Reporting”, “International”, “Firm”, “Value” and “Adoption”. Figure (9) also presents a word cloud related to this thematic area, created from the abstracts of the articles. The most frequently used terms in the image include “Financial Reporting”, “IFRS”, “Adoption”, “Fair Value”, “International Accounting”, “earning Management”, “Financial Statement”, “Value” and “Performance”. The findings in this section of the research are consistent with a significant number of terms from previous sections.

Table 5. Distribution of Keywords in IFRS Based on the Co-Occurrence Rate of Words

Rank	Co-occurred Keywords	Occurrences
1	Accounting standards - IFRS	26
2	Earning management - IFRS	24
3	Accounting standards - regulation	23
4	Disclosure - IFRS	19
5	IFRS – corporate governance	12
6	IFRS – accounting quality	12
7	Value relevance - IFRS	10
8	Corporate social responsibility – sustainability reporting	10
9	IFRS – m41	9
10	Globalization - IFRS	8
11	Financial reporting - IFRS	8
12	International accounting - IFRS	7
13	Fair value - IFRS	7
14	IFRS – information asymmetry	6
15	Accounting - asymmetry	6
16	M41 – g10	5
17	Comparability - IFRS	5
18	IFRS – standard setting	5
19	IFRS - translation	5
20	IFRs - transparency	5
21	IFRs foundation – sustainability reporting	5
22	Conservation - IFRS	5
23	M41 – m41	4
24	Financial reporting – standard setting	4
25	G10 – g30	4
26	IFRs – public sector accounting	4

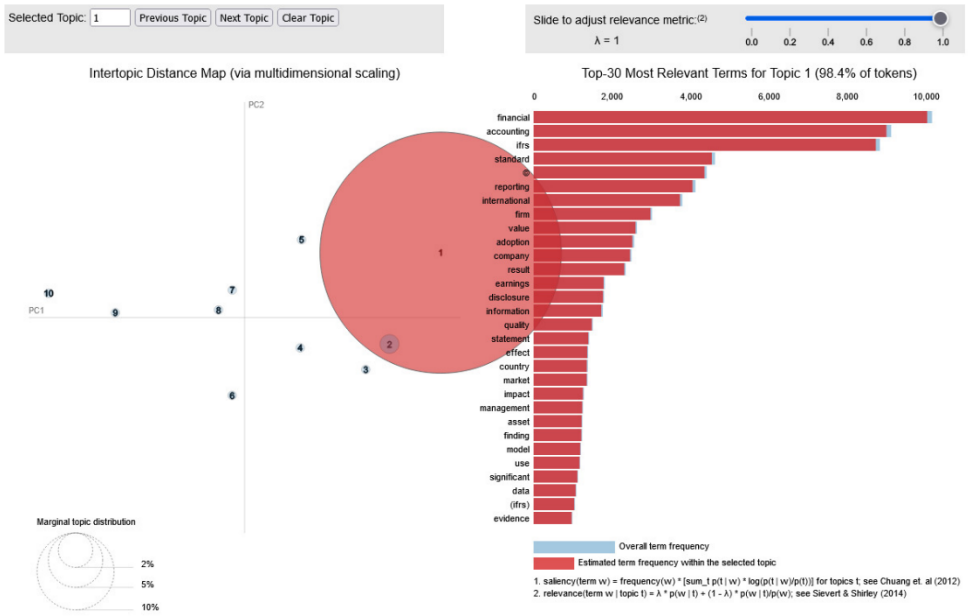


Figure 8. Topic modeling result with LDA

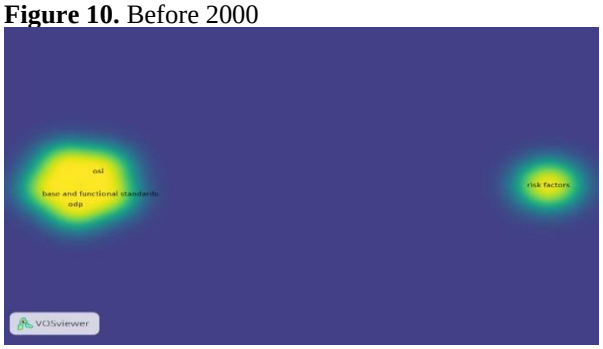
Figure 9. Cloud word in IFRS articles

3.10. The frontier of knowledge in IFRS

To illustrate the clear and enhanced delineation of knowledge boundaries and their development over time, the authors utilized keywords assigned by the authors of the articles shown in Figures (10), (11), (12), and (13). These authors are typically experts in their respective scientific domains and play a significant role in advancing their fields. Heat maps based on the article keywords were categorized into different time intervals to examine trends in topic changes over time. According to Table (6), the topics in the yellow-shaded area represent the highest density of articles, indicating the hot research topics that have garnered researchers' attention during that time interval. In this research, IFRS's concepts and research domain were divided into four time periods, as indicated in Table (6). Analyzing the thematic trends of articles reveals that this scientific domain was relatively underdeveloped before the year 2000, with limited attention from researchers focusing primarily on specific concepts such as risk factors and qualitative standards. From 2001 to 2010, prominent concepts included IFRS, financial reporting, corporate governance, statements of cash flows, accounting standards, international financial reporting, regulations, the International Accounting Standards Board (IASB), and globalization. During the period from 2011 to 2020, the scope and breadth of concepts in this scientific domain expanded significantly, encompassing issues such as earnings management, earnings quality, desirable value, cost of capital, accounting laws, organizational theory, social responsibility, audit costs, voluntary disclosure, firm value, credit risk, adoption, culture, protection, financial reporting quality, audit quality, emerging markets, sustainability, ethics, comprehensive reporting, insurance, standard setting, responsiveness, private companies, public interest, debt costs, drivers, financial crises, financial performance, transparency, disclosure, harm, liability, capital costs, information asymmetry, and real earnings management, among others. In the fourth time period, from 2021 onwards, researchers have focused on concepts such as earnings comparison, public health and policy, COVID-19 and pandemics, international financial reporting, credit risk, official institutions, financial stability, developing countries, banks, integrated reporting, non-financial reporting, desirable value, the International Accounting Standards Board, information, conceptual frameworks, comparability, audit costs, stability, corruption, disclosure, information asymmetry, voluntary disclosure, mutual funds, investor protection, national culture, earnings management, financial development, capital structure, corporate performance, organizational environment, sustainable development, environmental

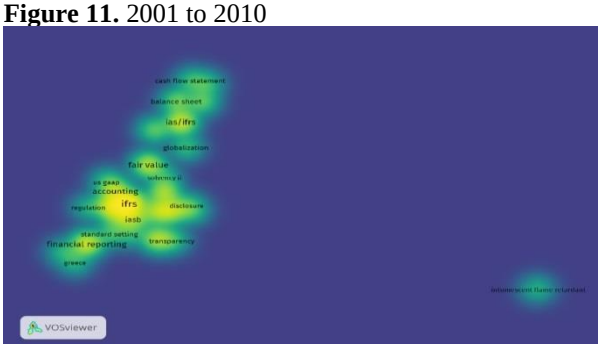
performance, global reporting initiatives, auditing, FAIR (Findable, Accessible, Interoperable, Reusable) data frameworks, accounting laws, standards, harmonization, risk assessment, blockchain, intangible assets, Islamic accounting, accounting changes, systematic risk, the banking sector, the International Sustainability Standards Board, auditors, audit information quality, stakeholders, joint investments, cryptocurrencies, debt costs, climate change, tax avoidance, financial leverage, standards setting, public sector accounting, and valuation.

Figure 10. Before 2000



Base and functional standards, quality standards, risk factors

Figure 11. 2001 to 2010

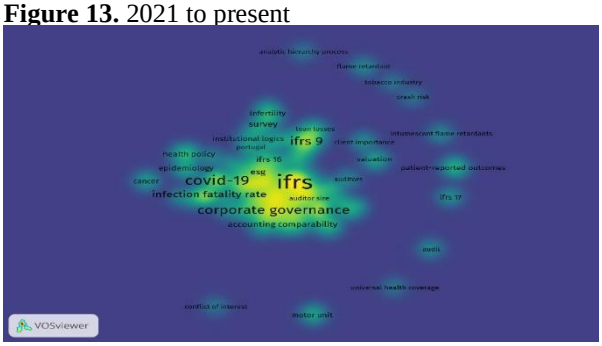


IFRS, accounting standards, financial reporting, fair value, international accounting standards, international financial report, corporate governance, cash flow statement, regulation, globalization, international accounting standard board

Figure 12. 2011 to 2020

Earnings management, earnings quality, desirable value, cost of capital, accounting laws, organizational theory, social responsibility, audit costs, voluntary disclosure, firm value, credit risk, adoption, culture, protection, financial reporting quality, audit quality, emerging markets, sustainability, ethics, comprehensive reporting, insurance, standard setting, responsiveness, private companies, standards, public interest, debt cost, drivers, financial crises, financial performance, transparency, disclosure, harm, liability, capital cost, information asymmetry, real earnings management.

Figure 13. 2021 to present



Comparison of earnings, public health, and policymaking, COVID-19 and pandemic, international financial reporting, credit risk, official institutions, financial stability, developing countries, banks, integrated reporting, non-financial reporting, desirable value, International Accounting Standards Board (IASB), information, conceptual frameworks, comparability, audit costs, sustainability, corruption, disclosure, information asymmetry, voluntary disclosure, mutual fund, investor protection, national culture, earnings management, financial development, capital structure, company performance, organizational environment, sustainable development, environmental performance, global reporting initiatives, auditing, Financial Accounting Standards Board (FASB), accounting regulations, standards, harmonization, risk assessment, blockchain, intangible assets, Islamic accounting, accounting changes, systematic risk, banking sector, International Sustainability Standards Board (ISSB), auditors, audit information quality, stakeholders, joint investment, cryptocurrencies, debt costs, climate change, tax avoidance, financial leverage, standard setting, public sector accounting, and valuation.

5. Conclusion

The significance and value of the IFRS have attracted the attention of researchers from various countries. With the increasing interest in this field, the current study aims to map the knowledge landscape, analyze collaboration networks among authors and countries, and delineate the boundaries of research within this domain. To achieve these objectives, scientometric methodology and data mining techniques were employed. Scientific collaborations are highly significant today and crucial in advancing knowledge. The specialization of sciences and the emergence of interdisciplinary fields have prompted researchers to explore all dimensions and aspects of research through collaboration. By further investigating these concepts, researchers can gain deeper insights into the complexities of scientific domains, identifying potential areas for future studies and interventions. Collaborative networks, such as co-authorship networks, are social networks formed by the collaboration of two or more authors who have co-authored at least one research paper. The analysis of macro-level network indicators revealed that the co-authorship network of researchers in the IFRS field is relatively weak in terms of network density. Specifically, only about five percent of all possible connections within this network have been established. This suggests a lack of strong coherence in the network, although there is considerable potential for establishing relationships among nodes (authors). The research also indicated that a small number of authors possess high degrees of centrality, while many others have lower degrees of centrality. In the co-authorship network of IFRS researchers, influential figures such as Tarca, Luzi, Edward, Christian, and Martin play a central role in the flow of information and knowledge transfer within the network. An analysis of the co-authorship network among countries revealed that the United States, the United Kingdom, Australia, Germany, Italy, Canada, Spain, France, and China hold the highest centrality rankings. Countries with high centrality are particularly significant in connecting various nodes and enhancing the coherence and cohesion of the network. They occupy a central position in the network and play a vital role in disseminating knowledge. The trend in IFRS research indicates that the highest number of publications in this field occurred between 2010 and the present. English is the predominant language, and accounting journals in Europe, particularly those associated with Macquarie University in Australia and the universities of California and Arizona in the United States, are among the leading scientific organizations in this field. This information is pertinent for those seeking to facilitate scientific collaborations and research opportunities, such as postdoctoral researchers.

The term co-occurrence was employed to illustrate the conceptual landscape of research in the IFRS field. This approach effectively highlights emerging trends and tracks research issues over time, as keywords provide a high-level summary of texts. Understanding research issues in scientific domains offers valuable insights into the development of the field for other researchers. Analyses of this nature are significant because they attract researchers and specialists to these keywords and research trends, facilitating further development. The analysis of frequently occurring keywords in the realm of IFRS reveals a predominant focus on concepts closely related to financial reporting, profit management, standard adoption, corporate governance, and disclosure. Additionally, the research examines thematic trends and knowledge boundaries across different periods within this scientific domain. Based on these findings, the research can be categorized into several classifications, highlighting the diverse nature of inquiry in this field.

- Adoption and Implementation of IFRS: This research area examines adopting and implementing IFRS across various countries. It explores the challenges and benefits of these standards, their adaptability, comparative studies, coordination and convergence initiatives, stimuli, mechanisms that enhance audit quality, and the reporting requirements involved.

- Regulation of Standards and Regulatory Frameworks: Research in this category examines the development, evolution, and interpretation of standards, the roles of regulatory bodies, authorities, and supervisory boards, legal trends, policymaking, and the acceptance and revision of standards.

- Quality and Transparency in Financial Reporting: This section explores the impact of IFRS on the quality, transparency, and comparability of financial reporting. It addresses management practices, the quality of profits, the effectiveness of control mechanisms, trust, usefulness, and the ability of these standards to achieve their defined objectives.

- The Consequences of IFRS: Research in this area examines the economic and other effects of adopting IFRS. This includes analyzing market effects, corporate performance, market efficiency, capital costs, and decision-making processes. Additionally, it assesses the impact on stakeholders, markets, investors, and analysts while evaluating the implications for investment and capital markets.

- Corporate Governance: This study examines the reciprocal relationship between IFRS and corporate governance and the impact of these standards on corporate accountability and ethical conduct.

- IFRS and Emerging Issues: This section of research focuses on innovative approaches to financial reporting, including sustainability, disclosure practices, advancements in digital reporting, globalization, social responsibility, emerging markets, valuation models, public health, unified reporting, voluntary disclosure, national culture, sustainable development, environmental performance, blockchain technology, the banking sector, information quality, joint investments, cryptocurrency, and the impacts of climate change.

This comprehensive classification highlights the multifaceted nature of research in the field of IFRS, encompassing various dimensions and opportunities for scholars and researchers.

6. Research Limitations and Implications for Future Research

In the present study, a comprehensive and holistic examination of research in the IFRS field was conducted using scientometric methodology and social network analysis. This research highlights trends in the domain, identifies major journals, explores country collaborations, and analyzes influential partnerships among researchers and authors and the topics discussed within this field. The findings of this study assist researchers in gaining a clearer understanding of the current state of research in this area. By examining the evidence of the existing research landscape, scholars can deepen their comprehension of the literature and develop innovative initiatives to further contribute to the scientific advancement of this domain. While this research offers a scientific exploration of the status and patterns present in IFRS research, it is not without limitations. The search strategy employed in this study was confined to two primary keywords: “IFRS” and “IFRS,” both of which are restricted to English. Consequently, it is possible that additional research from other databases in various languages, utilizing diverse methods and tools for mapping the scientific landscape, could yield a more comprehensive overview of the prevailing state of research in this field. Future studies could incorporate other databases, such as Web of Science and Google Scholar, to provide a more holistic perspective on IFRS research. Furthermore, by examining the findings and topics presented in the scientific maps of this domain, a pertinent question arises: Have all potential issues in this field received adequate attention from researchers? To address this question, a more in-depth exploration of the literature on IFRS was undertaken to identify challenges and research needs. The following suggestions aim to enhance understanding of this research domain and foster knowledge development in this scientific area: 1. Future acceptance of IFRS worldwide and its prospective trajectory. 2. A comprehensive review of the literature on IFRS. 3. Identification of empirical evidence regarding national acceptance of IFRS. 4. Development of a coherent theoretical

framework and validation of existing empirical results. 5. Examination of strategies employed by different countries to balance domestic accounting traditions with IFRS. 6. Assessment of the capacities of various countries for the complete adoption of standards. 7. Exploration of the relationship between national-level acceptance of standards and their acceptance at the corporate level. 8. Identify challenges related to standard adoption at the national level for companies in practice. 9. Evaluation of companies' readiness for standard adoption and identification of factors influencing this readiness. 10. Analysis of the complexity and interpretation of standards. 11. Investigation of challenges associated with the acceptance and convergence of standards. 12. Development of effective strategies for the adaptability of standards. 13. Examination of the adaptability of standards in light of technological and innovative developments. 14. Study of the economic and social impacts of standard adoption. 15. Identification of pathways for coordination and convergence. 16. Consideration of ethical issues and integrity in financial reporting. 17. Investigation of public trust in financial reporting; 18. The study of public trust in financial reporting; 19. the impact of IFRS on stakeholders' financial decision-making; 20. An examination of the quality and effectiveness of IFRS; 21. An analysis of the role of IFRS in corporate governance and responsiveness; 22. comparative studies of IFRS; 23. An investigation into the environmental impacts of IFRS; 24. An assessment of the effects and consequences of IFRS on sustainable and responsible investment.

These recommendations, derived from the findings and topics discussed in the scientific literature of this domain, emphasize the need for future researchers to focus on various aspects for a more comprehensive understanding and further development of knowledge in this field.

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