# The Relationship between Intellectual Capital Components and Audit Market Competition

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## Abstract

The present study aims to assess the relationship between intellectual capital and competition in the audit market.

The audit market concentration index is used to measure competition in the audit market, calculated according to three auditor concentration indices, client concentration and competition pressure. The study period is from 2013 to 2017, during which 705 firm-years is selected among the listed firms on the Tehran Stock Exchange as the sample of the study and is tested using the panel method.

The results indicate a negative and significant relationship between human, structural, and relational capital and auditor concentration. There is a positive and meaningful relationship between relational and structural capital and client concentration and a negative and significant relationship between human capital and client concentration. Furthermore, the relationship between structural and relational capital and competition pressure of rivals is positive and meaningful. The relationship between human capital and the competition pressure of competitors is negative and significant.

This paper enables the firms to lower their auditors' fees by employing exert and experienced people in making the best use of intellectual capital. This paper also causes the wise people to benefit from all production capacities of the firm. It enhances products' sales to increase the competition in the audit market and sometimes lower clients' costs for audit fees.

**Keywords:** Intellectual Capital, Audit Market Concentration, Human Capital, Structural Capital, Relational Capital

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# 1. Introduction

After several decades, we have witnessed global growth from the industrial economy to the knowledge economy. The firms attempt to create value and competitive advantage (Lev, 2004) and direct their attention to success factors, developing intangible assets and knowledge. IC is a significant source of firm innovation and human advancement through knowledge. As a general rule of thumb, knowledge and qualifications are two main factors of production. Learning, development, and frequent renovation have turned into an organisation's main capabilities to uphold the competition (Drucker, 1988). Hence, organisations are more interested in the evaluation, management, and development of their intellectual assets. This challenge for both academia and experts has led to the advent of the Intellectual Capital (IC) approach (Bontis, 1999; Roos & Roos, 1997). Furthermore, high concentration is to the benefit of the audit market because it enables the auditors to develop their expertise in pursuing complicated audit processes, which leads to saving in scales (Choi et al., 2017).

The present study analyzes the relationship between intellectual capital indices and audit market completion, measured by the audit market concentration index. In this paper, a relationship is built between audit market concentration, which is derived from three indices (auditor concentration, client concentration, and the competitive pressure of rivals), and intellectual capital components (human, structural, relational capital), which is indicative of a positive relationship between structural and relational capital and client concentration and the competitive pressure of rivals and a negative relationship between human capital and auditor concentration and client concentration and the competitive pressure of competitors. These results would increase the firm's net sales by strengthening the labour force, infrastructures, relations, foreign policies, and raising the audit fee. This paper is the first study compiled on the relationship between intellectual capital and audit market concentration, enabling firms to lower auditors' fees by recruiting experienced people and utilizing intellectual capital. Further, under such circumstances, wise people can benefit from all the firm's production capacity, which will elevate the sales of products and the competition in the audit market.

In some cases, this process would lead to lower audit fees to satisfy the management's objectives for lowering the client's costs, so audit market concentration can be associated with the intellectual capital by having expert members, and advanced technology fees can be reduced. The firms' motivation for strengthening intellectual capital will be improved. The information reported concerning the intellectual capital would lead to a decrease in information asymmetry and the improvement of beneficiaries' decision-making.

# 2. Theoretical principles
## 2.1. Intellectual capital

IC can be defined as an amalgamation of all kinds of knowledge and recognition of capabilities that allow the firms to achieve or uphold their stable competitive advantage. IC can also be defined as a combination of human, organisational, and relational resources and series of activities of an organisation, which includes knowledge, skills, experiences, and capabilities of staffs, organisational procedures, policies, and systems and all related resources to foreign relations of the firm, like customers, suppliers, research and development partners, etc. (Maria Diez et al., 2010). IC is under the title of intangible assets (IA) and appears in the form of knowledge, brand, patent, trademarks, customer relations, human capital, and research and development. Intellectual capital plays a significant role in an organisation's success or failure (Meles et al., 2016; El-Bannany, 2008), resulting in value creation for firms. IC is analysed as an incentive for firm value, which converts the production resources to properties with added value)( Lari Dashtbayaz et al., 2020).

The recognised difference between the book value of the firm and market value (MV) is related to covert values that are not recognisable in the annual reports. Therefore, IC is proposed to describe the gap between the firm's market value and book value (Lev, 2004). Stewart (1997) states that IC assesses the intellectual resources, knowledge, experience, information, competition, and learning of those organisations used for wealth creation.

However, El Tawy & Tollington (2012) perceive no universal definition of intellectual capital. The cause of effect relationship is between intellectual capital and value creation (Zeghal and Maaloul, 2010). The problems concerning IC investments' evaluation are increased agency costs derived from information asymmetry between the firm and foreign investors (Lev, 2004). The IC investment features may cause inappropriate selection, moral hazard, and managers' opportunistic behaviour (Holland, 2006). Based on a comprehensive study in IC literature during a decade, Guthrie, Ricceri, and Dumay (2012) defined IC accounting as an accounting, reporting, and managing technologies related to organisations to understand and manage knowledge resources. More specifically, this approach attempts to overcome the classifications and criteria of intangible assets and limitations of conventional financial indices used to describe, measure, and manage organisational performance. Ricceri and Guthrie (2009) investigate the IC framework and classify them according to two stock approach methods, the aim of which is to create a decentralised financial value and flow approach based on the content creation of knowledge resources. The IC is divided into three groups: human capital, structural capital, and relational capital (Rehman et al., 2011; Nimtrakoon, 2015; Bontis et al., 2015; Abdollah and Sufiyana, ٢٠١٢).

### 2.1.1. Human capital

Human capital includes the personal knowledge of the staff. Human capital is to pursue an organisation's objectives as a career and knowledge capital and the relational capital (ties and relations with customers, colleagues, dealers, and foreign partners). HC refers to a set of knowledge, qualification, innovation, commitment, and capability (Morris, 2015). Such knowledge is personal, which belongs to firms and the main objective of human capital in innovation and improving the staff (Abdollah and Sufiyana, 2012; Lopez et al., 2012). Moreover, Bontis (2002) explains human capital as a collective capability of an organisation to extract the staff's best solution. Chen et al. (2004) express that human capital as the cornerstone of intellectual capital refers to factors like knowledge, skill, capability, and attitude of the staff, which leads to the improvement of performance for which the customers are willing to pay.

### 2.1.2. Structural capital

Structural capital (SC) comprises the firms' most valuable strategic properties, including organisational, cultural processes, inventions, copyright, trademarks, database, etc. (Denicolaiet al., 2015). SC includes all non-human knowledge warehouses in organisations that belong to the organisation (Stewart, 1997; Roos et al., 1997; Bontis et al., 2000). Let's consider that SC includes the firms' most valuable strategic properties. Understandably, the staff has enough time to adapt to organisational characteristics, including culture and processes. In the long term, SC contributes positively to firms' financial performance, which involves organisational routines, policies, customs, datasets, etc. (Chen and et al. 2004). According to Skandia's report, structural capital comprises factors like organisational culture, information management, and datasets. Chen et al. (2004) believe that structural capital is more clearly classified in organisational culture, organisational learning, operational process, and information system. Roos et al. (1997) declare that structural capital is all those things that remain in the organisation

when the staff goes back home, which is elicited from processes and organisational policies.

### 2.1.3. Relational capital

Relational capital (CEE) includes all foreign relations like official business cooperation and other unofficial communications with international institutions, including customers, suppliers, banks, and non-profit organisations. Moreover, Chen et al. (2004) classify the relational capital in marketing ability, market intensity, and customer loyalty. In general, it works as a connecting bridge in the process of intellectual capital. Therefore, the growth of relational capital relies on the support of human capital and relational capital. RC is knowledge acquired by establishing relations with foreign beneficiaries (Yu et al., 2015). RC comprises relationships with partners outside the firm and other relational resources, like reputation, trademark, and loyalty. Relational capital (CEE) contributes to the financial performance of firms in the short run. For example, through special exercises or spare time activities, creating a positive working environment and cooperation inside the firm may lead to the staff and managers' motivation to enjoin their attempts to propose relatively new solutions (Agostini, Nosell and Filippini, 2017).

### 2.2. Audit market concentration

To measuring the competition in the audit market, the audit market concentration index is used, which is comprised of three indices of auditor concentration, client concentration, and competition pressure of rivals. Recent reports in the United States, the UK, and European Union express some concerns about audit market concentration by Big 4 audit firms and the potential effect such focus could have on the audit markets and audit quality general accounting office (GAO), 2003; governmental accounting office, 2006, 2007, 2008; the United States, 2006 and 2008). Recently, GAO voiced some concerns relative to audit market concentration, which may increase audit costs and lower audit quality. However, the present literature shows that local audit markets are more concentrated on lower audit fees and fewer accounting amendments. When the audit market includes fewer customers or small customers, audit market concentration audit costs have an ascending trend.

In contrast, in markets where there are many customers or big customers, audit market concentration would reduce audit costs (Salehi et al., 2020a). The European Commission issued a "green card" on October 13, 2010, concerning the Big 4 accounting firms' persistent threats in audit concentration and suggested that several mechanisms for lowering the concentration and elevating the competition should be selected from non-Big4 firms (European Commission, 2010). In September 2011, European Commission declared that it would put forward a suggestion to the European Parliament to modify the domination of the Big 4 and also ask for some other amendments, including the prohibition of audit firms from presenting non-audit services and the creation of net audit firms, compulsory audit rotation, and shared mandatory audit where the auditor should be among the non-Big 4 auditors. The second objective is to lower the audit market's partnership with the Big 4 to reduce these firms (accounting period, 2011). Although on November 30, 2011, the European Commission offered a series of strictly confidential suggestions with some significant changes forcing the audit firms in every six years and prohibiting non-audit services for audit customers. After the collapse of Arthur Anderson, the Sarbanes Oxley Act in 2002 has resulted in the United States' audit accounting investigation by the General Accounting Office, which showed that only a few local and international large firms could handle large audit projects. State-owned firms increase the concentration by the potential selection of price, quality, and significance, while no report is evident concerning the negative consequences of domination on the Big4 market. The

considerable changes in this profession may influence the competition and the selection of general firms, especially in specific industries. The tracking report of the Government Accountability Office (2008) also warned about potential adverse effects of market concentration. However, this report reminds us of the lack of enough studies in this field. In all these reports, the unsubstantiated claim is that concentration in audit markets is detrimental (partially, indeed) because the absence of competition decreases the Big 4 auditors' motivation to carry out high-quality audits. Audit market concentration debilitates the quality of audit results. The quality of audit results is computed using the statistical characteristics of audit earnings given total reimbursement, unnatural commitments, earnings report probability (avoiding losing), and to recognise timely losing officially. Results indicate that both big auditors and non-Big ones present high quality in countries with the highest percentage of complete audits (B4 SHARE). These results illustrate that the domination of the Big 4 does not hurt the audit quality, and it seems. Indeed, that audit quality is higher for Big 4 and non-Big4 firms, reflecting the market demand for high-quality audits in these countries, where low-quality audits are not satisfactory.

## 2.3. The relationship between the components of intellectual capital and auditor concentration

Two approaches exist in this regard, which will be explained in the following:

First approach: the higher the human capital or the workforce's expertise, the higher the payment should be, so auditor concentration is directly associated with the audit fee increase. Moreover, the presence of technology, inventions, and secure databases increases auditor concentration as much as they ask for a higher payment (Salehi et al., 2020b). The growth of firm capability in investment and relations with customers and foreign institutions brings about the increase of audit costs or, in other words, the audit fee, and this would enhance auditor concentration. In general, by increasing the industry's audit fee, audit services, and firm performance will be improved. Like the results (Eshleman, & Lawson, 2016; Huang et al., 2015; Newton et al., 2013), this study employs an auditor concentration index for audit market concentration. The lower this index would be, the higher is the competition in the market. Since audit market concentration is negatively associated with competition in the audit market (Boone et al., 2012), it is hypothesised that audit quality will increase in competitive conditions by increasing audit market size.

Lower competition of audit markets with higher payment would probably increase audit quality (Palmrose et al., 2004). According to the results of Eshleman and Lawson (2016), along with the rise in audit market concentration, audit quality will increase. Moreover, they also perceived that concentration is associated with higher audit quality in the contract's early years. The concentration increase would enhance the client's audit quality and reduce the auditors' adjusted opinion and improve the audit quality directly through an increase in audit fees (Huang et al., 2015).

Second approach: If the intellectual capital or intangible asset increases in a firm, this indicates the growth of that business firm, equal to more complications. The auditor is faced with higher pressure and risk, so auditor concentration is lower.

Bramhandkar et al. (2007) show a significant relationship between intellectual capital components and firm performance. Flavio et al. (2007) indicate a positive relationship between firms' intellectual capital components and financial performance. Pew Tan, Plowman, and Hancock (2007) state that intellectual capital and firm performance are positively interrelated, and the intellectual capital growth rate is also positively associated with firm performance. Kamath (2008) illustrates a significant relationship between intellectual capital components and financial performance criteria, but human capital has

the highest effect on performance among the intellectual capital components.

Cheng et al. (2010) show a remarkable relationship between intellectual capital and firm performance. Such results show that firms would be able to improve their performance through human capital. The results of Zaghal and Maaloul (2010) reveal that intellectual capital is positively and significantly associated with economic performance and financial performance. Huang et al. (2015) find a positive relationship between audit market concentration and audit quality.

Maditions et al. (2011) illustrate no relationship between intellectual capital and financial performance and the stock market but find a significant relationship between human capital and equity return. Boone et al. (2012) figure out that the audit market's high concentration would lead to the decline of earnings quality and audit quality. Eshleman (2013) shows a positive and significant relationship between audit market concentration and audit quality. He also indicates that audit quality will decrease by increasing audit market size in a highly concentrated market and finds that audit market concentration is negatively associated with competition in the audit market. Newton et al. (2013) perceive that an increase in audit market concentration is not associated with a decrease in the chance of financial restatement. In contrast, Dumany and Garanina (2013) substantiate that structural capital is mainly essential for RI in terms of cooperation of partners/ business networks, and structural capital and intellectual capital are among the reducing factors. Stankeviciene and Liucvaitiene (2012) state that the result of intellectual capital evaluation relies on the firm size, its activity, and managers' view on-demand for measuring intellectual capital.

Min Lu et al. (2014) indicate that intellectual capital is considerably associated with firm performance in the insurance industry and such a relationship is also positive and significant. Further, paying attention to intellectual capital may be beneficial for the firm and investors. According to Dummy (2016), if intellectual capital makes monetary, profitability, social, and stable value for the firm, the firm's financial and market performance will be improved. Eshleman and Lawson (2016) indicate that audit quality increases along with increased audit market concentration. They also conclude that concentration is associated with higher audit quality in the early years of contract with the client. Rehman et al. (2011) perceive that human capital has a positive and significant effect on firms' performance.

Gou, Siah-Hou, and Chien (2012) find a positive relationship between technological innovation and financial performance. Additionally, their findings present a coherent framework for establishing a relationship between the compensation plan, human capital, and biotechnology firms' financial performance. Clark et al. (2011) show a direct relationship between intellectual capital and firms' financial performance. Moreover, a positive relationship was found between intellectual capital (human and structural capital) and the current year's financial performance in the previous year. Nimtrakoon (2015) finds a positive and significant correlation between human capital and firms' financial performance. Sekhar et al. (2015) indicate a non-linear relationship between family ownership and intellectual capital disclosure. This study also shows that external ownership, board independence, and an audit committee's presence positively impact intellectual capital disclosure. Huang et al. (2015) demonstrate that the increase of concentration would lead to audit quality improvement of the client's firm, reducing the need to present auditors' adjusted opinions through increasing audit fees.

Moreover, this study suggests that concentration enhances audit quality directly through an increase in audit fees. Huang et al. (2015) discover a positive relationship between audit market concentration and audit quality. Eguasa (2017) expresses that the audit market concentration elevates audit quality. Chi, Sing, and Lew (2017) argue a mutual relationship between different intellectual capital kinds. Besides, social capital has

a significant mediatory role in the relationship between IC and CCO performance. Moreover, the business has a moderator, and a positive role and environmental distrust have some adverse effects on social capital and CCO performance.

**H₁:** There is a positive and significant relationship between human capital and auditor concentration.

**H₂:** There is a positive and significant relationship between structural capital and auditor concentration.

**H₃:** There is a positive and significant relationship between relational capital and auditor concentration.

## 2.4. The relationship between intellectual capital components and client concentration

A firm with strong relations with customers, suppliers, institutions, and banks will cause people's attraction, the growth of the sales market, and increased client concentration. Broadly, client concentration goes up along with the rise in sales in the industry. By threatening to change the auditor to a new one, the client may stage a competition. Newton et al. (2013) believe that less competition in the audit market will reduce the risk of losing a client, so the chance of amity between auditor and client and independence loss is extremely lower, and less competition will increase audit quality. In contrast, within a concentrated audit market, auditors are more likely to be overconfident, leading to decreased audit quality (Boone et al., 2012). Additionally, more competition in the audit market may cause the auditors to ask for lower fees. Such a decline may cause them not to perform their duties appropriately and hurt the audit quality. Zeghal and Maaloul (2010) indicate that intellectual capital performance is positively associated with financial and economic performance. Still, about the market value in the technology industry, this is only a significant relationship. Boone et al. (2012) perceive that audit market concentration is associated with a high chance of analysts' predicted earnings. Moreover, the results show a positive relationship between audit market concentration and the quality of discretionary accruals.

Wang (2013) indicates a positive relationship between Tobin's Q ratio and the value-added coefficient of intellectual capital. Using profitability variables, Bontis et al. (2013) measure total properties, return on assets, return on equity, staff efficiency, and banks' performance. The results of this study indicate that human capital considerably affects staff efficiency. Tsenget et al. (2011) approve its positive impact on the financial performance of firms. Morris (2015) fined a positive and significant relationship between human capital and firms' financial performance. Su et al. (2013) discover that customer capital and human capital will enhance new product development. Maditions et al. (2011) discover that only structural capital is significant. There is no relationship between other human capital and intellectual capital return (ROE) and return on assets and income growth rate. Enzo Dia (2009) shows a significant relationship between intellectual capital components and financial performance, which indicates the high impact of relational capital, compared with other intellectual capital components, on performance and agility in financial issues.

**H₄:** There is a positive and significant relationship between human capital and client concentration.

**H₅:** There is a negative and significant relationship between structural capital and client concentration.

**H₆:** There is a positive and significant relationship between relational capital and client concentration.

## 2.5. The relationship between intellectual capital components and the competitive pressure of rivals

The enlargement of a business firm contributes to the auditor fee because it is one example of audit fee determination. The expansion of a business firm asks for higher audit risk and, consequently, higher audit fees. The competitive pressure of rivals is the third concentration and audit market competition index (Newton et al., 2015). When there is fierce competition in the audit market, auditors acquire more markets with fewer audit fees than the previous year. The less the difference, the higher is the competition. Wu et al. (2007) show that organisational capital and relational capital generally distinguish the relationship between HC and new product development in Taiwanese firms' framework in the electronic industries and information technology. Change (2007) indicates that a relationship between intellectual capital components and relational capital has the highest competitive advantage. El-Bannany (2008) shows that investment in information technology, bank efficiency, and investment efficiency in intellectual capital significantly impact intellectual capital performance. Also, he demonstrates that profitability variables and bank risk are also substantial. Wang and Cheung (2004) reveal that Tobin's Q ratio and the value-added ratio of intellectual capital have a positive relationship with firm value. Cho et al. (2011) perceive that intellectual capital is not associated with the capital return and market to book value ratio. Still, there is a positive relationship between this factor and return on assets and a negative turnover. Also, they conclude that there is a significant relationship between intellectual capital components and some performance criteria, and the critical point here is that the relationship between human capital and profitability is negative. Mondal and Ghosh (2012) conclude a positive and significant relationship between firms' intellectual values added ratio and financial performance criteria. Mura et al. (2012) express that intellectual capital has a directive role and creates innovative organisations' innovative behaviours by sharing knowledge. Nazari et al. (2010) claim that structural capital has a positive and significant relationship with firms' financial aspects; moreover, there is a positive relationship between human capital and firm performance. Chen et al. (2014) conclude that intellectual capital has positive and significant effects on efficiency changes. Therefore, to obtain sustainable productivity growth, insurance companies should invest considerably in intellectual capital because, in this way, managers' managerial skills will go up, which is itself one of the critical factors in efficiency increase. Chiucchi & Montemari (2016) indicate a mutual relationship between three intellectual capital elements and their performance. They also show that water distribution companies in Romania have most of the intellectual capital components. Hence, we can declare that the proposed model for investigating intellectual capital impacts such as firms' organisational performance. Estrin, Mickiewicz, and Stephan (2016) assess the effects of human capital on technological entrepreneurship. They conclude that human capital contributes to the commercial entrepreneurship of such countries. Choi et al. (2017) find a direct relationship between the audit market concentration and audit fee.

**H7:** There is a positive and significant relationship between human capital and the competitive pressure of rivals.

**H8:** There is a negative and significant relationship between structural capital and the competitive pressure of rivals.

**H9:** There is a positive and significant relationship between relational capital and the competitive pressure of rivals.

## 3. Research Methodology

Audit concentration model

AC= β + βHC + βSC +βCC + LEV +LOSS + INDUSTRY +EXPORT + SIZE + ROA

$+\varepsilon$

Client concentration model

CC= β + βHC + βSC +βCC + LEV +LOSS + INDUSTRY +EXPORT + SIZE + ROA $+ ^{\varepsilon}$

Rivals' pressure

CP= β + βHC + βSC +βCC + LEV +LOSS + INDUSTRY +EXPORT + SIZE + ROA $+ ^{\varepsilon}$

### 3.1. Dependent variable

Auditor concentration (AUDIT_HHI): Herfindahl index from dividing audit fee into total auditor's fees in the industry

Client concentration (CLIENT_HHI): Herfindahl index from dividing net sales of the current year into total industry sales

Competitive pressure of rivals (DISTANCE_IND): percentage of audit fee change in proportion to the previous year (audit fee of the last year – audit fee/audit fee of the past year)

$$CP = \frac{\text{audit fees of the previous year} - \text{audit fees}}{a\text{udit fees of the past year}}$$

### 3.2. Independent variable

Intellectual capital ($VIAC_{it}$): includes human capital ($HCE_{1t}$), structural capital ($SCE_{2t}$), and relational capital ($CCE_{3t}$), which is computed using the Pulic model.

1- Human capital ($HCE_{it}$): is the capabilities, skills, and expertise of the human organisational force, which is considered as the total salary cost of the firm.
2- Structural capital ($SCE_{it}$): Knowledge remains in the organisation at the end of each day and belongs to the organisation. It encompasses some factors like patent rights, dataset, and organisational charts and is computed by dividing human capital (total paid salary of the firm) into added value.
3- Relational capital ($CCE_{it}$): knowledge exists in the firm's relations with customers, shareholders, beneficiaries, rivals, and state-owned institutions, like contracts and agreements (through book value of all firm properties minus intangible assets).

### 3.3. Control variable

LEV: financial leverage: total debts to total assets;
LOSS: firm loss, if the firm is losing 1, otherwise, 0;
INDUSTRY: virtual variable of industry
EXPORT: if the firm has exports 1, otherwise, 0;
Sizeit: natural logarithm of firm sales in the year under study;
ROAit: return on assets, net profit to total assets ratio.

### 3.4. Statistical population, statistical sample, and data collection method

The statistical population of the present study includes all listed firms on the Tehran Stock Exchange. The reason for selecting the statistical community is to gain access to available data in financial statements of the listed firm on the Tehran Stock Exchange. The number of remained firms for hypothesis testing is 141 firms, five years, 705 year-company.

To gathering the data, library method and documentary studies were used and to obtain the desired data for hypothesis processing, the available information of Rah Avard Novin Software is used, and financial statements of the listed firm on the Tehran Stock Exchange were analysed by visiting the official website Tehran Stock Exchange and Codal.

The statistical method of regression analysis is used for hypothesis testing using

Eviews Software.

## 4. The Results
### 4.1. Descriptive statistics

**Table 1.** The descriptive statistics

| Variable | Mean | Median | Max. | Min. | Std. dev. | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| Auditor concentration | 0.023 | 0.006 | 0.542 | 0.000 | 0.048 | 4.763 | 35.223 |
| Client concentration | 0.051 | 0.023 | 0.870 | 0.000 | 0.091 | 4.085 | 24.885 |
| Competitive pressure of rivals | 0.266 | 0.159 | 12.738 | -1.000 | 0.978 | 6.900 | 70.330 |
| Human capital | 0.136 | 0.175 | 1.647 | -7.5780 | 0.587 | -9.695 | 118.438 |
| Relational capital | 17.010 | 13.725 | 486.796 | -923.586 | 77.252 | -5.531 | 75.842 |
| Structural capital | 0.863 | 0.953 | 11.367 | -38.380 | 1.619 | -20.037 | 495.033 |
| Industry 1 | 0.149 | 0.000 | 1.000 | 0.000 | 0.356 | 1.972 | 4.889 |
| Industry 2 | 0.057 | 0.000 | 1.000 | 0.000 | 0.231 | 3.832 | 15.685 |
| Industry 3 | 0.128 | 0.000 | 1.000 | 0.000 | 0.334 | 2.231 | 5.980 |
| Industry 4 | 0.262 | 0.000 | 1.000 | 0.000 | 0.440 | 1.080 | 2.166 |
| Industry 5 | 0.128 | 0.000 | 1.000 | 0.000 | 0.334 | 2.231 | 5.980 |
| Industry 6 | 0.120 | 0.000 | 1.000 | 0.000 | 0.326 | 2.330 | 6.431 |
| Industry 7 | 0.092 | 0.000 | 1.000 | 0.000 | 0.289 | 2.819 | 8.948 |
| Industry 8 | 0.014 | 0.000 | 1.000 | 0.000 | 0.118 | 8.217 | 68.514 |
| Industry 9 | 0.050 | 0.000 | 1.000 | 0.000 | 0.217 | 4.147 | 18.195 |
| Financial leverage | 0.618 | 0.613 | 2.315 | 0.090 | 0.250 | 2.052 | 13.568 |
| Loss | 0.146 | 0.000 | 1.000 | 0.000 | 0.353 | 2.004 | 5.016 |
| Return on equity | 0.110 | 0.106 | 0.705 | -2.444 | 0.187 | -3.820 | 53.443 |
| Export | 0.915 | 1.000 | 1.000 | 0.000 | 0.279 | -2.971 | 9.826 |
| Firm size | 13.862 | 13.816 | 18.44048 | 10.121 | 1.355 | 0.440 | 4.093 |

Audit concentration in the first model (ac) with a maximum value of 1. and the maximum amount of 0. Moreover, client concentration in the second model (cc) with the maximum value of 1.740 and minimum value of 0, and in the model of competitive pressure of rivals (cp), the maximum amount of 29737.93% and the minimum amount is -200%. Moreover, in independent variables, including human capital (HCE), the maximum value of 7521771 and a minimum amount of 870.

Given the F test results, the p-value in all three models and all three modes is less than 0.1, so H0 is rejected, and a panel with fixed effects is approved.

Given the values of Chi-square statistics resulted from the Breusch-Pagan test based on the above table, the coefficient in all three models and both modes (cross-section, cross-section, and time) is less than 0.1, so the H0 is rejected, and the panel with random effects is approved.

Given the Hausman test results, p-values in all three models are less than 0.1, so H0 is rejected, and a panel with random effects is used.

**Table 2.** The results of F-Limer (chow), Breusch-Pagan, and Hausman tests for the first, second, and third model

| Description | F-Limer (cross-section) | | F-Limer (time) | | F-Limer (cross-section and time) | | Breusch-Pagan (cross-section) | | Breusch-Pagan (time) | | Breusch-Pagan (cross-section and time) | | Hausman test | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Sig. | Statistic | Sig. | Statistic | Sig. | Statistic | Sig. | Statistic | Sig. | Statistic | Sig. | Statistic | Sig. | |
| Model 1 | 47.60 | 0.000 | 2.930 | 0.000 | 41.440 | 0.000 | 1099.300 | 0.000 | 1.600 | 0.200 | 1101 | 0.000 | 8.890 | 0.003 | Model has fixed cross-sectional and time effects |
| Model 2 | 38.500 | 0.000 | 4.070 | 0.000 | 37.700 | 0.000 | 653 | 0.000 | 1.350 | 0.240 | 655 | 0.000 | 9.070 | 0.001 | Model has fixed cross-sectional and time effects |
| Model 3 | 21.800 | 0.000 | 4.150 | 0.010 | 21.500 | 0.000 | 302 | 0.000 | 0.920 | 0.330 | 303.400 | 0.000 | 11.190 | 0.000 | Model has fixed cross-sectional and time effects |

In this stage and after specifying the appropriate estimation method for final model fitting and before final estimation, it is first necessary to analyze the primary receptors of regression models. Hence, in the following, we investigate the classic hypotheses of multiple regressions.

**4.2. Variance heterogeneity**

The first basic receptor understudy for the model related to hypothesis testing is the variance heterogeneity of model residuals, for which the variance coefficient tests are used with the following results:

**Table 3.** The results of variance heterogeneity

| H0 | Test statistic | p-value | Result |
|---|---|---|---|
| Series with variance homogeneity | 1.03 | 0.17 | H0 is accepted: series has variance homogeneity |
| H0 | Test statistic | p-value | Result |
| Absence of serial autocorrelation | 1.47 | 0.22 | H0 is accepted: series has no autocorrelation |

The second hypothesis of the regression model hypothesis is the absence of the first-order autocorrelation among model residuals. In the first, second, and third model, the Durbin-Watson statistic is a number equal to 1.560, 2.143, and 2.391, respectively, and there is no autocorrelation among residuals. Moreover, the results related to the test of residual correlation are presented in the following:

Given the obtained results from the variance inflation factor and the relationship between the independent variable, VIF, and relationship values are not high in these two variables, there is no collinearity among variables.

**Table 4.** Test results of the first model

| Variables | Symbol | Regression coefficient | Std. dev. | T statistic | Sig. |
|---|---|---|---|---|---|
| The constant value of the model | C | 0.031 | 0.003 | -8.680 | 0.000 |
| Relational capital | CCE | -0.001 | 0.001 | -2.691 | 0.0073 |
| Structural capital | SCE | -0.000 | 8.74E-06 | -13.158 | 0.000 |
| Human capital | HCE | -8.37E-07 | 5.17E-08 | -16.190 | 0.000 |
| Industry 1 | INDUSTRY01 | 0.008 | 0.004 | 1.719 | 0.086 |
| Industry 2 | INDUSTRY02 | 0.011 | 0.004 | 3.190 | 0.001 |
| Industry 3 | INDUSTRY03 | 0.003 | 0.001 | 4.441 | 0.000 |
| Industry 4 | INDUSTRY04 | 0.035 | 0.001 | 29.479 | 0.000 |
| Industry 5 | INDUSTRY05 | 0.021 | 0.007 | 3.240 | 0.001 |
| Industry 6 | INDUSTRY06 | 0.011 | 0.001 | 11.430 | 0.000 |
| Industry 7 | INDUSTRY07 | 0.004 | 0.000 | 11.960 | 0.000 |
| Industry 8 | INDUSTRY08 | -0.003 | 0.000 | -5.146 | 0.000 |
| Financial leverage | LEV | -0.000 | 0.001 | -0.158 | 0.874 |
| Loss | LOSS | 0.001 | 0.001 | 0.869 | 0.385 |
| Return on equity | ROA | 0.010 | 0.003 | 0.343 | 0.731 |
| Export | EXPORT | -0.010 | 0.001 | -12.042 | 0.000 |
| Firm size | SIZE | 0.003 | 0.000 | 9.473 | 0.000 |
| Coefficient of determination | | 0.569 | F statistic of model | | 55.783 |
| The adjusted coefficient of determination | | 0.536 | Probability F statistic of model | | 0.000 |

As can be seen in Table 4, given the t statistic at the significance level of coefficients and regression coefficient sign of each variable of relational capital (-0.001), structural capital (-0.000), and human capital (-8.37E$^{-07}$). The significance level is less than 0.1, we can conclude that there is a negative and significant relationship between relational capital and structural capital and human capital and auditor concentration and also in control variables given the significant level of more than 0.1, there is no meaningful relationship between financial leverage, loss, and return on equity and auditor concentration. At a significance level of less than 0.1, there is no significant relationship between export industry, firm size, and auditor concentration. We can say that intellectual capital contributes negatively to audit concentration, so the first hypothesis is accepted.

The model's determination coefficient is 0.565, which shows existing descriptive variables in the model elucidate 56% of changes in the dependent variable.

**Table 5.** Test results of the second model

| Variables | Symbol | Regression coefficient | Std. dev. | T statistic | Level of significance |
|---|---|---|---|---|---|
| The constant value of the model | C | -0.009 | 0.108 | -0.084 | 0.933 |
| Relational capital | CCE | 0.043 | 0.008 | 5.099 | 0.000 |
| Structural capital | SCE | 0.004 | 0.001 | 2.056 | 0.040 |
| Human capital | HCE | -0.000 | 0.000 | -3.378 | 0.001 |
| Industry 1 | INDUSTRY01 | -0.065 | 0.006 | -10.560 | 0.000 |
| Industry 2 | INDUSTRY02 | -0.015 | 0.005 | -3.207 | 0.001 |
| Industry 3 | INDUSTRY03 | -0.079 | 0.006 | -12.809 | 0.000 |
| Industry 4 | INDUSTRY04 | -0.039 | 0.005 | -7.657 | 0.000 |
| Industry 5 | INDUSTRY05 | -0.067 | 0.007 | -10.15 | 0.000 |
| Industry 6 | INDUSTRY06 | -0.026 | 0.005 | -5.624 | 0.000 |
| Industry 7 | INDUSTRY07 | -0.063 | 0.008 | -8.062 | 0.000 |
| Industry 8 | INDUSTRY08 | -0.121 | 0.008 | -15.527 | 0.000 |
| Financial leverage | LEV | -0.126 | 0.027 | -4.733 | 0.000 |
| Loss | LOSS | 0.010 | 0.022 | 0.442 | 0.659 |
| Return on equity | ROA | 0.066 | 0.091 | 0.724179 | 0.469 |
| Export | EXPORT | -0.011 | 0.060 | -0.183 | 0.855 |
| Firm size | SIZE | 0.015 | 0.006 | 2.406 | 0.016 |
| Coefficient of determination | | 0.569 | F statistic of model | | 2.275 |
| Adjusted coefficient of determination | | 0.536 | Probability F statistic of model | | 0.003 |

As can be seen in Table 5, given the t statistic at the significance level of coefficients and regression coefficient sign of each variable of relational capital (0.043), structural capital (0.004), and human capital (-0.000). The significance level is less than 0.1. We can conclude a positive and significant relationship between relational capital and structural capital, and client concentration. The relationship between human capital and client concentration is negative and significant. Moreover, given the significant level of more than 0.1, there is no meaningful relationship between losses, return on equity, export, firm size, and client concentration, and given the significant level of less than 0.1, there is a significant relationship between the variable of industry, financial leverage, and client concentration, so the second hypothesis is accepted.

Moreover, the F statistic and its probability are equal to 2.275 and 0.000, respectively,

indicating model significance.

**Table 6.** Test results of the third model

| Variables | Symbol | Regression coefficient | Std. dev. | T statistic | Level of significance |
|---|---|---|---|---|---|
| The constant value of the model | C | -0.232 | 0.007 | -30.930 | 0.000 |
| Relational capital | CCE | 0.032 | 0.005 | 5.829 | 0.000 |
| Structural capital | SCE | 0.007 | 0.003 | 2.299 | 0.022 |
| Human capital | HCE | -5.58E-05 | 1.64E-05 | -3.401 | 0.001 |
| Industry 1 | INDUSTRY01 | -0.071 | 0.008 | -9.183 | 0.000 |
| Industry 2 | INDUSTRY02 | -0.013 | 0.004 | -3.438 | 0.001 |
| Industry 3 | INDUSTRY03 | -0.084 | 0.008 | -10.728 | 0.000 |
| Industry 4 | INDUSTRY04 | -0.044 | 0.005 | -8.035 | 0.000 |
| Industry 5 | INDUSTRY05 | -0.068 | 0.004 | -14.98 | 0.000 |
| Industry 6 | INDUSTRY06 | -0.0370 | 0.006 | -5.861 | 0.000 |
| Industry 7 | INDUSTRY07 | -0.065 | 0.008 | -7.707 | 0.000 |
| Industry 8 | INDUSTRY08 | -0.126 | 0.007 | -17.89 | 0.000 |
| Financial leverage | LEV | -0.192 | 0.027 | -7.183 | 0.000 |
| Loss | LOSS | 0.005 | 0.001 | 6.237 | 0.000 |
| Return on equity | ROA | 0.003 | 0.001 | 2.754 | 0.006 |
| Export | EXPORT | -0.010 | 0.069 | -0.151 | 0.880 |
| Firm size | SIZE | 0.023 | 0.001 | 21.813 | 0.000 |
| Coefficient of determination | | 0.724 | F statistic of model | | 66.586 |
| Adjusted coefficient of determination | | 0.713 | Probability F statistic of model | | 0.000 |

As shown in Table 6, given the t statistic at the significance level of coefficients and regression coefficient sign of each variable of relational capital (0.032), structural capital (0.007), and human capital ($-5.58E^{-05}$). The significance level is less than 0.1. We can conclude a positive and significant relationship between relational capital and structural capital and rivals' competitive pressure. The relationship between human capital and the competitive pressure of competitors is negative and significant. Moreover, given the significant level of less than 0.1, there is a significant relationship between industry variables, leverage, return on equity, firm size, and the competitive pressure of rivals, and given the significant level of more than 0.1 in the variable of export, there is no relationship between export and the competitive pressure of competitors, so the third hypothesis is accepted.

## 5. Conclusion

The results show that there is a negative and significant relationship between human, structural, and relational capital and auditor concentration, which means the more these three intellectual capital components go up, the less is the auditor concentration; this finding in line with Nazari et al. (2010) and contrast to Rehman et al. (2011), Chen et al. (2004), Chang Wang et al. (2012), Tsenget et al. (2011). Further, there is a positive relationship between relational and structural capital and client concentration, which means the increase in relational and structural capitals would lead to a rise in client concentration. Moreover, there is a negative relationship between human capital and

client concentration, in line with the result of Nazari et al. (2010). The findings show a positive relationship between relational and structural capital and rivals' competitive pressure, which means the increase in relational and structural capitals would lead to a rise in competitors' competitive pressure.

Furthermore, there is a negative relationship between human capital and the competitive pressure of rivals. In conformity with such results, Enzo Dia (2009), Abdullah and Friha (2012). The presence of contradictory results in the audit market concentration is that auditors' range of audit fees is calculated according to working pressure and volume and is closer to standard in different countries. In Iran, this amount is hugely higher than the standard in some firms due to no market stability and vice versa.

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