Design and validation of capital efficiency model in Tehran Stock companies

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Abstract

This research has been investigated with the aim of modelling and validating capital efficiency in listed companies. The statistical community is in the meta-analysis section, internal and external research with research keywords. The research methods used are meta-analysis, interpretive structural stratification and confirmatory factor analysis. The sampling method in the meta-analysis section is purposeful and articles with unique keywords in the current research field have been used. The statistical population in the confirmatory factor analysis section was the experts of the Stock Exchange Organization, who were selected by simple random sampling. For confirmatory factor analysis in this research, 250 people participated in the questionnaire. In this research, by using the meta-analysis method and reviewing the articles in question, first, the effective components of capital efficiency in listed companies were identified. According to the importance of each variable in the financial statements of listed companies, the model was stratified, and then with The use of confirmatory factor analysis the paths related to each variable were investigated. The results show the appropriate fit of the proposed model and at the 95% level, all paths of the proposed model are approved.

Keywords: capital efficiency, return on capital, stock exchange companies
2020 MSC: Primary xxxxx (mandatory); Secondary xxxxx, xxxxx (optionally)

1 Introduction

Productivity is a comprehensive and general concept, increasing it as a necessity, raising the standard of living, more welfare, peace and comfort of people and is considered a basic goal for all countries of the world. In today's world, improving productivity is one of the national priorities of every country, because the continuation of economic life and the improvement of the living standards of people in a society depend on improving productivity. In the macro discussion of the country, the increase or growth of productivity leads to an increase in economic growth, control of the inflation rate, an increase in economic competition, an increase in per capita income, a decrease in costs, and an increase in the gross domestic product, etc., and because the gross domestic product Dividing by the country's population represents the per capita income, therefore improving productivity will lead to an increase in the wealth shared among the members of the society [7].

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Today, due to the limitations of various production factors, there is a vital need for increased productivity, both in developed countries and in developing countries. Experts and economic experts in different systems have practically emphasized the importance of increasing productivity in the same way [15].

The issue of productivity was taken into consideration for the first time in the second program and in the form of Note 35. In Iran's third economic development plan, no specific goal for productivity was considered. In the fourth economic development program of the country, special attention was paid to the category of productivity and certain general goals were considered for its improvement. Increasing productivity is not only the concept of optimal use of resources. Rather, it helps to create a better balance between economic, social and political structures in the society [26].

The beginning of using the word productivity in economic cultures dates back to two centuries ago. In many parts of the world and in industrialized countries, productivity is considered as a way of thinking and culture and thinking to advance and improve what exists. The International Labor Organization defines productivity in this way [5]. Productivity is the ratio of output to one of the factors of production (land, capital, labor and management). Productivity measures are obtained by dividing the total output of the organization by one of the production factors such as materials, labor, energy and capital [22].

Since the last decades, it is believed that the degree of economic development of countries depends on the optimal use of available resources and facilities in order to achieve their economic goals. Increasing productivity is not only the concept of optimal use of resources, but also helps to create a better balance between economic, social and political structures in society [13]. Productivity is very important in development. Comprehensive development is not possible without optimal use of each of the production factors. One of the factors of production is capital. Man, who is the main means of all-round development, can take a simpler and faster path to achieve development by using the capital factor and the advancement of capital technology used by increasing capital productivity [4]. Productivity defined as the power and ability to produce [10]. Productivity is a comprehensive and general concept whose increase is considered as a necessity to improve the standard of living, greater welfare, peace and comfort of humans and is considered a basic goal for all countries of the world [14]. On the other hand, the increase in productivity affects the economic indicators of the society, such as increasing production, reducing inflation, increasing the level of employment and the competitiveness of countries [16]. The concept of capital efficiency measures the ability of management in the optimal use of capital as one of the important and limited resources of the company, and it is expected that the stocks of companies with high capital efficiency have higher performance [17].

2   Theoretical foundations and research background

At this stage of the research, articles, books and reports in Persian and English were reviewed and the components of the research were counted. These studies are as follows:

Abbaspour and Orhan [1] was investigated the interactive effect of capital efficiency and accounting conservatism on the cost of capital in the Tehran Stock Exchange and the stock exchange. The research sample included 118 companies admitted to the Tehran Stock Exchange during the year. 1385 to 1394 and 194 companies admitted to the Istanbul Stock Exchange during the period of 2006 to 2015. This research examines the relationship between accounting conservatism and cost of capital, emphasizing the role of capital productivity in the form of the following assumptions and regression models. According to the findings of this research, capital productivity has an effect on the relationship between conservatism based on the temporal asymmetry of profit and cost of capital.

Sogham and Javadinia [25] was examined the effect of managers' ability on investment efficiency in companies listed on the Tehran Stock Exchange. To achieve this goal, 99 companies from Accepted in the Tehran Stock Exchange were selected as a sample and were examined during the period of 1378-1393. The statistical population of the research is the companies admitted to the Tehran Stock Exchange. The duration of the research period is seven years from 1378 to 1393. The results show that financial reports as one of the information sources available in the capital markets can play an effective role in the development of investment and increasing its efficiency. But the important issue is that company managers are responsible for preparing and presenting financial reports.

In a research of Satish and Mansouri [24], the effect of corporate governance mechanisms on the efficiency of working capital management of companies listed in "Tehran Stock Exchange" was investigated. Effective management of working capital is vital for most companies. In this research, the statistical sample of the research includes 98 companies in the period from 1386 to 1390. The findings of the research show that there is no significant relationship between the size of the board of directors and the efficiency of working capital management; Because the size of the board of directors of the studied companies is close to 90% of them and it affects the estimation results; Also,

considering the lack of effect of the size of the board of directors on the efficiency of working capital management, it seems that the size of the board of directors does not have the necessary efficiency to reduce the conflict of interests between stakeholders and representation costs due to inappropriate use in Iran, and the role of corporate governance mechanisms in Iran is not in accordance with the representation theory; Therefore, the ability of this monitoring tool to improve the efficiency of capital management in the circulation of companies is weak.

In Moradzadeh Fard [20] research, investment efficiency and the risk of falling stocks, acknowledged that the purpose of this research is to examine the effect of managerial ability on the investment efficiency of companies listed on the Tehran Stock Exchange and to examine the effect of investment efficiency on the risk of falling stock prices of listed companies. In Tehran Stock Exchange, they investigated the effect of managerial ability on investment efficiency. The statistical population of the present study includes all the companies admitted to the Tehran Stock Exchange between 2017-2018. The results of the research showed that managerial ability has a positive effect on investment efficiency, so that if the managerial ability of one unit increases, the investment efficiency increases by 0.0005 units; The risk of stock price fall in the first benchmark of the previous year and investment efficiency has a negative effect on the risk of stock fall, so that if the risk of stock price fall in the first benchmark of the previous year and investment efficiency increases by one unit, the risk of stock fall decreases by 0.8 and 1.54 units, respectively. Finds; The risk of stock price fall, the second criterion of the previous year and investment efficiency has a significant negative effect on the risk of stock fall, so that if the risk of stock price fall, the second criterion of the previous year and investment efficiency increase by one unit, the risk of stock fall is 0.07 and 1.81 units, respectively.

Mohammadzadeh Saleteh et al. [19], in a study entitled the impact of investment opportunities, company growth and capital productivity on company performance in Iran's capital market, acknowledged that investors seek to increase their wealth. In this research, the effect of investment opportunities, company growth and capital efficiency on the performance of companies admitted to the Tehran Stock Exchange has been investigated. The statistical population of the research includes the companies admitted to the Tehran Stock Exchange, from which 134 companies were selected as a statistical sample based on the systematic elimination sampling method. The method of testing the hypotheses in this research was the combined data method. The results of the research show that investment opportunities do not affect the performance of the company and the growth of the company has a positive and significant effect on the return on assets and has an effect on the added value of the market. Also, capital efficiency has a positive and significant effect on company performance.

Mohammadpour et al. [18] in a study acknowledged that the concept of capital efficiency measures the ability of management to optimally use capital as one of the important and limited resources of the company, and it is natural that the shares of companies with high capital efficiency, have higher returns and also increase the explanatory power of the presented models to predict stock returns using capital efficiency. The purpose of this study is to investigate how capital productivity affects the explanatory power of stock return forecasting models and also to investigate this effect in different stages of the companies' life cycle. The statistical population of the research and the studied period are the years 2014 to 2015, and the selected sample is 110 companies from among the companies admitted to the Tehran Stock Exchange and with the defined characteristics. The results of the hypothesis test show that capital productivity has an effect on the relationship between the market factor and growth with risk taking in all stages of the life cycle, but it has a significant effect on the relationship between the size factor and risk taking only in the maturity stage.

Erza [9], conducted a study with the aim of investigating the effect of overconfidence of managers on capital efficiency and investigating the mediating role of intangible assets on this relationship in companies listed on the Tehran Stock Exchange. The current research has studied a sample of 194 companies from the shares of companies admitted to the Tehran Stock Exchange, which were selected by the systematic elimination method, for the time period of 2010-2015, on an annual basis. The results of this research showed that there is a significant relationship between managers' overconfidence and capital productivity, in addition, there is a significant relationship between managers' overconfidence and capital productivity considering the amount of investment in intangible assets.

In a research Hassas Yeganeh et al. [12] acknowledged that the accuracy of profit forecasting can affect investment efficiency. It is expected that by increasing the accuracy of profit forecasting, investment efficiency will increase and over-investment and under-investment will decrease. The time domain of this research is the 5-year period from the beginning of 1988 to the end of 1992, and the research sample includes 133 companies admitted to the Tehran Stock Exchange. The collected data has been compiled using Excel software in the form of information files. The present study showed that with the increase in the accuracy of the profit forecast, the investment efficiency increases and the excessive investment in capital expenditures decreases. Therefore, this information can be useful for investors in evaluating the management's performance in relation to investment decisions, the accuracy of the management's profit forecast can be used as a measure visible by external stakeholders for the company's investment efficiency be placed. In a study by Goker et al. [11], the analysis of the working capital efficiency of the companies listed in the

sustainability index was carried out using the index method. The aim of his study is to calculate the working capital management efficiency of 19 companies listed in the BIST Sustainability Index (XUSRD) created in 2014, between 2015 and 2018, using the index method developed by Bhattacharya [8]. In this research, the companies included in this index are examined every year since 2015 to create a homogeneous sample group in the samples. Since 2013 is the year of creation of this index, it is out of the observation period. The four years before 2015 (2013-2010 period) and the following four years (2018-2015 period) constitute the studied period. 19 companies listed continuously in this index from 2015 to 2018 constitute the study sample. This study examines the change in the effectiveness of working capital management before and after being listed in the sustainability index, and its purpose is to determine whether the resulting mathematical difference is statistically significant or not. Using the index method developed by Bhattacharya [8], it is observed that the working capital efficiency of many companies decreases after being listed in the sustainability index. Considering the working capital efficiency indices of companies, the number of companies whose working capital activity index is above 1 before 2014 was 10, 11, 15 and 10 in 2010, 2011, 2012 and 2013 respectively. After 2014, these numbers are 10, 9, 14 and 12 respectively. In two years after being included in the sustainability index, the number of companies whose working capital efficiency index is above 1 has decreased and will increase in the next 2 years. Effectiveness in working capital management depends on the performance and utilization of companies. When both performance and exploitation indicators are considered, it is observed that especially the exploitation indicators of companies decrease. Therefore, it is concluded that after listing in XUSRD, companies fail to use their current assets to generate sales revenue. The findings show that companies cannot manage their working capital well while fulfilling their commitments to realize sustainability. Since the investments made for sustainability show their benefits in the long term, costs should be well managed in the short term.

Norvaisiene [21] investigated the impact of capital structure on the performance of companies listed on the Baltic Stock Exchange. This research includes data from non-financial firms because the capital structure of financial institutions is known and the performance of these firms is affected quite differently. This research covers the period of 2002-2011. Data from 70 companies were used in this research: 28 Lithuanian companies, 14 Estonian companies and 28 Latvian companies. In order to investigate the mutual effect of the capital structure with the performance efficiency of the companies, a correlation analysis was performed between debt level indicators (long-term financial debt ratio, short-term financial debt ratio, financial debt ratio, non-financial debt ratio). This research showed that a higher level of financial debt has a negative effect on the profitability ratios of companies in the Baltic countries. Also, both financial and non-financial debts reduce the liquidity of companies.

Anton and Afloarei Nucu [6], investigated the impact of working capital management on firm profitability: empirical evidence from Polish listed companies. The purpose of this study is to investigate the relationship between working capital and company profitability for a sample of 719 Polish listed companies in the period 2007-2016. Data were collected from the Amadeus database, and the final sample consisted of 719 companies listed on the Warsaw Stock Exchange for the period 2007–2016, corresponding to 3,043 firm-year observations. The present results show that a quadratic model should be tested for each sample of companies. In terms of practical implications, Polish companies show an inverted U-shaped relationship between working capital and firm performance, meaning that managers must avoid negative effects on firm profitability through lost sales, lost discounts for upfront payments, or expenses. Avoid additional financing. The results show that financial managers of companies should avoid more net investment in working capital and aim for its optimal level, while internally generated funds can be directed towards more profitable investment opportunities. Reducing unnecessary working capital frees up unnecessary cash invested in financing day-to-day operating activities and increases the company's financial flexibility. Almomani et al. [3] investigated the impact of working capital management on the profitability of selected listed FMCG companies in India. Working capital management plays a vital role in the success of businesses due to its impact on profitability and liquidity. The purpose of this study is to investigate the relationship and efficiency of working capital management strategies of FMCG companies in India. This study used secondary data collected from all fifteen listed FMCG companies during the period 2013-2017. Using panel data analysis, this study finds a significant positive and negative relationship between profitability and working capital management. FMCG companies play a vital role in the Indian economy. It can be found to become one of the major FMCG markets for manufacturers and consumers. The current research was conducted with the aim of helping to understand short-term financial decisions by examining the key factors of working capital management.

Alarussi [2] investigated financial ratios and efficiency in Malaysian listed companies. This paper examines financial ratios that may have a significant impact on performance in Malaysian listed companies. Nine financial ratios measure seven variables, which are: visibility of the company, tangibility, working capital, leverage, liquidity, productivity and profitability. The data of this study is secondary data in nature and was collected from 108 non-financial companies extracted from the annual reports of the Malaysian Stock Exchange for the period between 2012 and 2014. However,

the total number of valid observations is 291. Which provides data for 97 companies. The study was chosen over this period because this is the period when the Malaysian currency depreciated to almost 50% of its value at the end of 2013, before stabilizing to 40% in 2019. The sample size was selected based on systematic random sampling. This study has selected financial ratios that theoretically play a role in determining the company's efficiency by examining previous studies. The results show that there is a positive and significant relationship between working capital (measured by log working capital) and company efficiency. The results show that this relationship is positive and significant. This strong positive relationship can be explained by the fact that every company should manage its daily expenses wisely in order to increase its efficiency.

Conducting any research requires determining and defining each of its variables. The variables identified in the research are as follows: Capital efficiency in listed companies is the main research variable.

Summary of researches

The variables extracted from previous researches under the title of "financial ratios" are as follows:

1. The ROE index of a company, from dividing the company's net income or net profit by the value of shares
2. Return on assets - ROA - net profit/total assets
3. Current Ratio- CA/CL- Current Assets/Current Liabilities
4. Ratio of working capital to total assets - WC/TA - working capital/total assets
5. Debt Ratio - TD/TA - Total Liabilities/Total Assets
6. Asset turnover ratio - NS/TA - net sales/total assets
7. Ratio of current assets to total assets - CA/TA - current assets/total assets
8. Ratio of operating profit to total assets - EBIT/TA - operating profit/total assets
9. Operating profit margin - EBIT/NS - Operating profit/net sales
10. ABILITY: management ability
11. EQ: Financial reporting quality
12. SIZE: The size of the company
13. KSTRUCTUR: The capital structure of the company
14. ROA: return on assets
15. DIV: dividend distribution
16. ATO: asset turnover
17. AGE: Omar Co
18. LOSS: loss index
19. RET: Average monthly stock return
20. LEV: financial leverage

3 Research methodology

Since the purpose of the research is to present the capital efficiency model in listed companies, it is practical in terms of the purpose, and its results are clear and objective, and the results of it are in meeting needs and solving problems and applying it in solving problems. It is specific in the organization, society, etc. Also, in terms of gathering information, the research is descriptive-survey. Because meta-analysis method is used in this research. The statistical community of domestic and foreign researches is investigated with research keywords. The sampling method was purposeful and articles with unique keywords were used in the current research field.

Table 1: Number of reviewed articles

	Persian and English articles	Persian and English books	English research reports
First round	The number of available articles is 125	The number of available books is 14	The number of available reports is 49
Second period	95 available articles	Book with approved title 18	Reports with approved title 41
Third period	Articles with approved abstracts 52	The number of approved books available is 11	Number of approved reports available 13
Fourth period	Articles with approved methodology 5	Books with approved content 3	Reports with approved content —
Fifth period	Articles with approved content 13		

The statistical population in the confirmatory factor analysis section was the experts of the Stock Exchange Organization, who were selected by simple random sampling. For confirmatory factor analysis, the minimum sample should be 200 people, and in this research, 250 people participated in the questionnaire. The data collection tool in this research is as follows:

1. In this research, the meta-analysis method and multivariate decision criteria are used for the qualitative part of the research.
2. The validity and reliability of the questionnaire was checked and confirmed. The validity of the questionnaire was confirmed through the face validity and reliability of the questionnaire with a pre-test on 20 people experimentally with the help of Cronbach's alpha 0.87.

The general steps of the meta-analysis method are as follows:

1. Formulating the research question, for example, using the PICO (Population, Intervention, Comparison, Outcome) model, which stands for Population, Intervention, Comparison, Outcome.
2. Search in the subject literature.
3. Selection of studies (interference criteria)

   - Based on qualitative criteria, for example, the need for randomization and no manipulation in a case study.

   - Choosing specific studies on a specific topic.

   - Decide whether unpublished studies are subject to publication bias or bias.

4. Deciding which dependent variables or statistical indicators are permissible or appropriate. For example, when considering meta-analysis, the data from published studies are aggregated as follows:

   - Differences (discrete data)

   - Mean (continuous data)

   - "Chi Hex" index is a popular measure and measure for continuous data that is standardized in order to eliminate the scale difference, but it is also affected by the measure of dispersion between groups. For example, $\delta = \mu t - \mu c \sigma$, where μt represents the mean of the treatment and μc also represents the mean of the control group. One way to eliminate the scale in comparisons is under the condition that $\sigma 2$ is the mixed variance of both groups.

5. Choosing a meta-analysis model, for example "Fixed Effect Model" or Random Effect Model, are common methods in meta-analysis model.
6. Meta-analysis uses heterogeneous and interdisciplinary sources. For example, the use of subgroup analysis (Sungroup Analysis) or "Meta Regression" are among the prominent methods in meta-analysis.

4 Research findings

After evaluating and confirming the identified measures effective on capital efficiency in listed companies, they are presented in Table 2.

Table 2: Effective measures on capital efficiency in stock exchange companies

Row	Identified factors
1	A company's ROE index, from dividing the company's net income or net profit by the value of the shares
2	Return on assets - ROA - net profit/total assets
3	Current Ratio- CA/CL- Current Assets/Current Liabilities
4	Ratio of working capital to total assets - WC/TA - working capital/total assets
5	Debt Ratio- TD/TA - Total Liabilities/Total Assets
6	Asset turnover ratio - NS/TA - Net sales/total assets
7	Ratio of current assets to total assets - CA/TA - current assets/total assets
8	Ratio of operating profit to total assets - EBIT/TA - operating profit/total assets
9	Operating Profit Margin- EBIT/NS - Operating Profit/Net Sales
10	ABILITY: management ability
11	EQ: Financial reporting quality
12	SIZE: Company size
13	KSTRUCTUR: The capital structure of the company
14	ROA: return on assets
15	DIV: Dividend
16	ATO: asset turnover
17	AGE: life of the company
18	LOSS: loss index
19	RET: Average monthly stock return
20	LEV: financial leverage

The sources related to each of the identified variables are provided. After 20 basic components affecting capital efficiency in listed companies were identified and according to the degree of importance of each of the variables in the financial statements of the companies.

4.1 Confirmatory factor analysis of data

The structural equation model is one of the new statistical methods and one of the most powerful multivariate analysis methods, and its main application is in multivariate subjects. Multivariate analysis refers to a series of analysis methods whose main feature is the simultaneous analysis of several independent variables with several dependent variables. Structural equations are from the multivariate regression family, which allows researchers to test a set of regression equations simultaneously [23].

$$n_t = \beta_1 + \beta_2 m_t + \beta_3 g_t + \varepsilon_{1t} \tag{4.1}$$

The model should be named according to the number of parameters of the model and the parameters should be entered into the model:

$$n_t = \beta_{11} + \beta_{12} m_t + \beta_{13} p_t + \varepsilon_{2t} \tag{4.2}$$

$$n_t = \frac{\{(\beta_1\beta_{13} - \beta_{11}\beta_3) + \beta_{13}\beta_2 g_t - \beta_3\beta_{12} m_t - \beta_3\beta_{14} n_{t-1} + (\beta_{13}\varepsilon_{1t} - \beta_3\varepsilon_{2t})}{\beta_{13} - \beta_3} \tag{4.3}$$

$$p_t = \frac{\{(\beta_1 - \beta_{11}) + \beta_2 g_t - \beta_{12}\beta_{12} m_t - \beta_{14} n_{t-1} + (\varepsilon_{1t} - \varepsilon_{2t})}{\beta_{13} - \beta_3} \tag{4.4}$$

$$erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt.$$

$$n = \max(n_1, n_2) \tag{4.5}$$

where:

$$n_1 = \left\lceil 50\left(\frac{j}{k}\right)^2 - 450\left(\frac{j}{k}\right) + 1100 \right\rceil \tag{4.6}$$

$$n_2 = \left\lceil \frac{2}{2H}\left(A\left(\frac{\pi}{6} - B + D\right) + H + \sqrt{\left(A\left(\frac{\pi}{6} - B + D\right) + H\right)^2 + 4AH\left(\frac{\pi}{6} + \sqrt{A} + 2B - C - 2D\right)}\right) \right\rceil \tag{4.7}$$

where:

$$A = 1 - p^2$$

$$B = parcsin\left(\frac{p}{2}\right)$$

$$C = parcsin(p)$$

$$D = \left(\frac{\delta}{z_1 - \alpha/2 - z_1 - \beta}\right)^2$$

where j is the number of observed variables, k is the number of latent variables, ρ is the estimated Gini correlation for a normal random vector of variables, δ is the predicted effect size, α is the corrected type I error rate, β is the type II error rate, and z is a standard score.

$$F(x; \mu, \sigma^2) = \frac{1}{2}\left[1 + erf\left(\frac{x - \mu}{\sigma\sqrt{2}}\right)\right] \tag{4.8}$$

where μ is the mean, σ is the standard deviation, and erf is the error function. Now the same steps can be done using software.

Goodness of model fit tests

As their name suggests, goodness-of-fit tests are used to determine whether a particular distribution is well-fitted. Calculating goodness-of-fit statistics also helps to rank the fitted distributions according to how well they fit the data.

- The first index- RMESA

$$RMESA = \frac{\sqrt{(X^2 - df)}}{\sqrt{[df(N-1)]}} \tag{4.9}$$

- The second index- GFI

$$GFI = 1 - \frac{F(S, \sum(\acute{\theta}))}{F(S, \sum(\cdot))} \tag{4.10}$$

- The third index – AGFI

$$AGFI = 1 - \frac{k(k+1)}{2d}(1 - GFI) \tag{4.11}$$

First, to enter the structural equations, the research tools must be subjected to confirmatory analysis to determine the validity of the structure. Confirmatory factor analysis was used to confirm each of the variables as well as the items related to each of them. In fact, confirmatory factor analysis is used to determine the appropriateness of the measurement model. The confirmation method tests the optimal fit of the observed and theoretical factor structures for the data set by determining the fit of the predetermined factor model. In this section, after a brief explanation about the fit indices of the confirmatory factor analysis related to each of the factors mentioned in the conceptual model, it is analyzed. It should be noted that in order to test the research model, modification indices were used to compile the final models, in addition, questions with low factor loadings were removed. Path analysis is presented according to Figure 1.
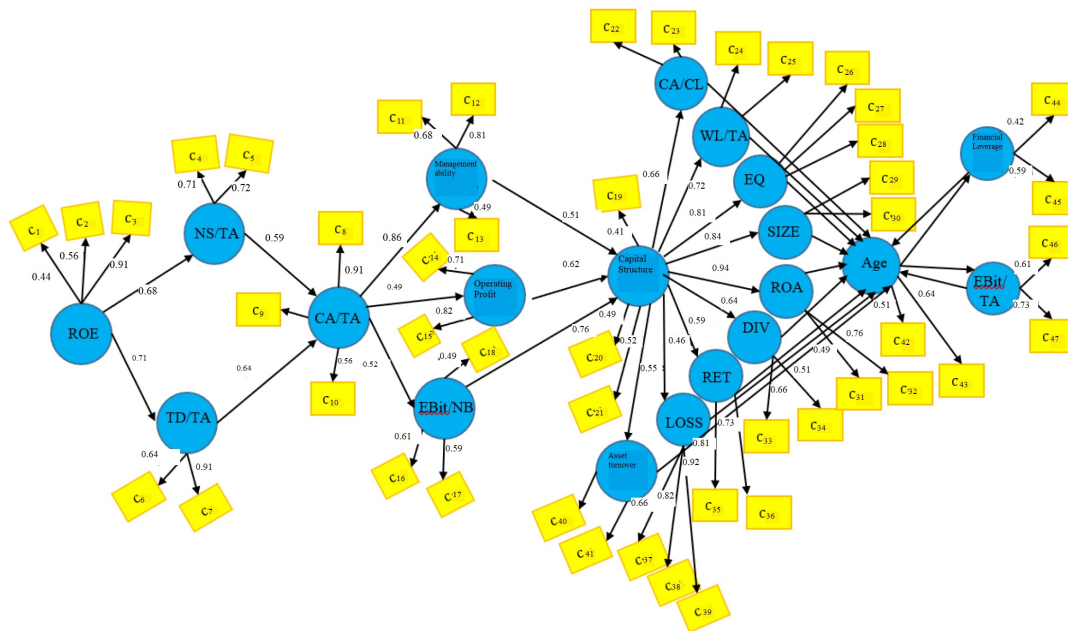

Figure 1: Diagram of model path analysis

Confirmatory factor analysis of first level variables

In order to determine the validity of the first level variables, confirmatory factor analysis method was used. The output of the software shows that all factor loadings are higher than 0.3. According to the output of the software, the calculated value of χ^2/df is 2.07, the presence of χ^2/df smaller than 5 indicates the appropriate fit of the model, and the root mean square error estimate (RMSEA) should be less than 0.08, which in The presented model is equal to 0.066. The amount of GFI, AGFI, CFI and NFI indicators should be more than 0.9, which is higher than the determined amount in the model under study. Therefore, the data of this research fits well with the factor structure of this scale and this indicates the alignment of the questions with the variables of the first level.

Second level confirmatory factor analysis

In order to determine the validity of the second level, confirmatory factor analysis method was used. All factor loadings are higher than 0.3. According to the output of the software in Table 4, the calculated value of χ^2/df is 1.80, the presence of χ^2/df smaller than 5 indicates the appropriate fit of the model, and the root mean square error

Table 3: Fit indices of first level variables

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	2.07	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.066	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.93	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	0.91	$AGFI > 0.9$
Comparative Fit Index (CFI)	0.96	$CFI > 0.9$
Softened Fit Index (NFI)	0.94	$NFI > 0.9$

estimation (RMSEA) should be less than 0.8 0, which in the presented model is equal to 0.057. The amount of GFI, AGFI, CFI and NFI indicators should be more than 0.9, which is higher than the determined amount in the model under study. Therefore, the data of this research fits well with the factor structure of this scale, and this indicates the alignment of the questions with the variables of the second level.

Table 4: Second level fit indices

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	1.80	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.057	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.94	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	0.92	$AGFI > 0.9$
Comparative Fit Index (CFI)	0.98	$CFI > 0.9$
Softened Fit Index (NFI)	0.97	$NFI > 0.9$

Confirmatory factor analysis of third level variables

The numbers on the paths are factor loadings, all factor loadings are higher than 0.3. According to the output of the software in Table 5, the calculated value of χ^2/df is 1.54, the existence of χ^2/df smaller than 5 indicates the appropriate fit of the model, and the root mean square error estimate (RMSEA) should be less than 0.08. Let it be that in the presented model this value is equal to 0.047. The amount of GFI, AGFI, CFI and NFI indicators should be more than 0.9, which is higher than the determined amount in the model under study. Therefore, the data of this research fits well with the factor structure of this scale, and this indicates the alignment of the questions with the variables of the third level of the phenomenon.

Table 5: Fit indices of third level variables

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	1.54	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.047	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.96	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	0.94	$AGFI > 0.9$
Comparative Fit Index (CFI)	0.99	$CFI > 0.9$
Softened Fit Index (NFI)	0.98	$NFI > 0.9$

Fourth level confirmatory factor analysis

In order to determine the validity of the fourth level, the method of confirmatory factor analysis was used. The numbers on the paths are factor loadings, all factor loadings are higher than 0.3. The findings related to the fit indices of the fourth level in Table 6 indicate that the CFI, GFI, NFI, RMR and RMSEA indices have an acceptable level and these characteristics show that the data of this research fit the factor structure of this scale. It has a good fit and this indicates the alignment of the questions with the structure of the fourth level.

Table 6: Fourth level fit indices

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	1.45	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.043	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.97	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	0.96	$AGFI > 0.9$
Comparative Fit Index (CFI)	1	$CFI > 0.9$
Softened Fit Index (NFI)	0.99	$NFI > 0.9$

Fifth level confirmatory factor analysis

In order to determine the validity of the fifth level, the method of confirmatory factor analysis was used. The numbers on the paths are factor loadings, all factor loadings are higher than 0.3. The findings related to the fit indices of the fifth level in Table 7 indicate that the CFI, GFI, NFI, RMR and RMSEA indices have an acceptable level and these good characteristics show that the data of this research fit the factor structure of this scale. It has a good fit and this indicates the alignment of the questions with the fifth level structure.

Table 7: Fifth level fit indices

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	1.63	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.041	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.91	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	0.93	$AGFI > 0.9$
Comparative Fit Index (CFI)	0.99	$CFI > 0.9$
Softened Fit Index (NFI)	0.99	$NFI > 0.9$

Sixth level confirmatory factor analysis

In order to determine the validity of the sixth level, confirmatory factor analysis method was used. All factor loadings are higher than 0.3. The findings related to the fit indices of the sixth level in Table 8 indicate that the CFI, GFI, NFI, RMR and RMSEA indices have an acceptable level and these good fit characteristics show that the data of this research fits the factor structure of this scale. It is appropriate and this shows the alignment of the questions with the structures of the sixth level.

Table 8: Sixth level model fit indices

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	2.2	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.039	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.92	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	1	$AGFI > 0.9$
Comparative Fit Index (CFI)	0.95	$CFI > 0.9$
Softened Fit Index (NFI)	0.97	$NFI > 0.9$

Seventh level confirmatory factor analysis

In order to determine the validity of the seventh level, the method of confirmatory factor analysis was used. All factor loadings are higher than 0.3. The findings related to the fit indices of the seventh level in Table 9 indicate that the CFI, GFI, NFI, RMR and RMSEA indices have an acceptable level and these good fit characteristics show that the data of this research fits the factor structure of this scale. It is suitable and this indicates the alignment of the questions with the structures of the seventh level.

Table 9: Seventh level model fit indices

Characteristic	Estimate	Fund
Chi-square ratio to degrees of freedom χ^2/df)	1.15	$\chi^2/df < 5$
Root mean square error estimate (RMSEA)	0.073	$RMSEA < 0.08$
Goodness of fit index (GFI)	0.92	$GFI > 0.9$
Adjusted Goodness of Fit Index (AGFI)	0.96	$AGFI > 0.9$
Comparative Fit Index (CFI)	0.98	$CFI > 0.9$
Softened Fit Index (NFI)	0.92	$NFI > 0.9$

Analysis of the model and checking the fit of the proposed research model

In this section, using the information collected through a questionnaire that was designed based on the indicators identified in the qualitative section and distributed among a statistical sample of the studied community. The indicators related to the components were quantitatively analyzed statistically and the results are given below. Fit criteria is one of the most important steps in structural equation modeling analysis. These criteria are to answer the question whether the model represented by the data confirms the measurement model of the research or not. To answer this question, many fit criteria have been introduced in structural equation modeling methodology.

1. The ratio of chi-square to degree of freedom: In the chi-square test, the compatibility of the hypothesis of the desired model with the covariance pattern between the observed variables is examined. Its smaller values, i.e. less than 3, indicate greater suitability. The quantity of chi-square is highly dependent on the size of the sample, and a large sample increases the quantity of chi-square more than it can be attributed to the wrongness of the model.

2. Goodness of Fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI):
   These indices show a measure of the relative amount of variances and covariances that are explained by the model. Both criteria are variables between zero and one, the closer they are to one, the better the fit of the model with the observed data.

3. The root mean (average) of the residuals (RMR): In this index, the residuals of the observed variances and covariances are compared with the estimates made in the model.
   Its smaller values are a sign of better fit. Models in which this value is less than 0.05 have a very high fit, but values between 0.05 and 0.08 are also suitable for a good model.

4. Root Mean Square Index (RMSEA): This index is 0.050 or less for good models, and a model in which this index is 0.10 or more has a poor fit. Table 10 shows the status of these indicators.

Table 10: The results of the fit indices of the research model

RMSEA	RMR	CFI	NFI	AGFI	GFI	χ^2/df
0.090	0.133	0.845	0.887	0.841	0.835	2.828

The results show the appropriate fit of the proposed model. After testing the measurement models, it is now necessary to provide a structural model that shows the relationship between the research variables. Using the structural model, research hypotheses can be investigated.

5 Conclusion and discussion

The stock exchange is a platform for investing and buying and selling securities. All securities and stock market instruments are under the supervision of the Stock Exchange Organization and their information is carefully checked by the experts of the Stock Exchange Organization. Therefore, the information of companies, funds and financial institutions on the stock exchange are much more reliable than the information of non-stock companies, and loss-making and non-transparent companies are removed from the stock market. Therefore, the stock market is a reliable and reliable platform for investing in productivity. By identifying the factors affecting the capital efficiency of companies, it provides the possibility of its accurate estimation.

The findings of this research are presented in the form of three general steps as follows:

Step 1. Identifying and defining the factors affecting capital efficiency in listed companies with a meta-analysis approach

Step 2. Interpretive structural modeling for extracted components and their stratification

Step 3. Validation of capital efficiency model using confirmatory factor analysis method

Step 1: Identifying and defining the factors affecting capital efficiency in listed companies with a meta-analysis approach:

At this stage of the research, first by reviewing the existing literature in the field of capital productivity with a meta-analysis approach, the dimensions and indicators of this model were identified. Meta-analysis is a type of research about other researches that deals with the systematic study and review of past researches. In this type of qualitative studies, the researcher uses information and findings extracted from other studies with a related and similar topic and provides a new combination of interpretations of selected studies. This part includes the following components:

Research problem: The first step of meta-analysis is setting research questions. What is the first question to start meta-analysis? The research question in this section is what are the factors affecting capital efficiency in listed companies?

Systematic review of texts: In this stage, the researcher systematically searches for articles published in various and reliable domestic and foreign scientific journals, as well as sources such as books and reports, with the aim of determining valid, reliable and relevant documents in the appropriate time frame. - pay

At this stage, first, English and Farsi keywords related to the research were selected. In the Persian section, the index words ROE, asset, working capital, total assets, debt, asset turnover, current assets, operating profit, operating profit margin, management ability, quality of financial reporting, company size, company capital structure, return on assets, division Dividends, asset turnover, company life, loss index, average monthly stock return and financial leverage were searched in Magiran database. In the English section, the following formula was used in Scopus database:

TITLE ("ROE index" OR "Property" OR "Working capital" OR "Total assets" OR "the debt" OR "Asset turnover" OR "Current assets" OR "Operating Profit" OR "Operating profit margin" OR "Ability to manage" OR "Quality of financial reporting" OR "size of the company" OR "Company capital structure" OR "Return on assets" OR "Dividends" OR "Asset turnover" OR "Company age" OR "Loss index" OR "Average monthly stock returns" OR "Financial Leverage") AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "j"))

In order to find other sources, including books, a search was made in Googlebooks, nlai.ir databases and in the report section of university sites and global and regional institutions and institutions such as the World Bank and the European Union. It should be noted that a search protocol was used in the systematic review of the texts. Based on this protocol, the time period studied for Persian studies was considered from 1380-1401 and foreign studies from 1895-2022. The language of the research was English and Farsi, and the type of studies were considered quantitative due to the use of meta-analysis, qualitative or mixed qualitative methods.

Searching and reviewing related articles: after searching for different sources in the form of books, articles and reports, various parameters such as the level of access to the entire source, title, abstract, content and overall quality of the article were considered and the sources that are proportional to the question and purpose of the research did not have, they were removed. The findings indicated the identification of 100 related scientific articles in scopous, 25 articles in the Persian sources section, 9 books and book chapters in the books.google section, 5 Persian books and 49 professional reports in English, of which 13 A completely relevant study was selected.

Extracting information from the articles: In this step, the researcher examines the sources in order to obtain the findings in them. This step was done very carefully to identify the main findings that can be extracted from the sources. At this stage, more than 100 codes were identified, which were examined in the form of focus group meetings in 2 rounds and reduced to 20 codes.

Step 2: Interpretive structural modeling for the extracted components and leveling

At this stage, the components confirmed in the previous stage have been classified and leveled using the degree of importance in the financial statements of listed companies with the MiMak software. According to the collected information, it was found that there are seven levels. Seven levels were identified and factors related to each level were extracted as follows.

First level: the ratio of operating profit to total assets - EBIT/TA - operating profit / total assets, company age, financial leverage

Second level: current ratio - CA/CL - current assets / current liabilities, ratio of working capital to total assets - WC / TA - working capital / total assets), quality of financial reporting, company size, return on assets, asset turnover, index Loss, average monthly stock return.

Third level: return on assets - ROA - net profit/total assets

Fourth level: operating profit margin - EBIT/NS - operating profit/net sales, management ability, capital structure of the company

Level 5: Current Assets to Total Assets - CA/TA - Current Assets/Total Assets

Sixth level: debt ratio - TD/TA - total liabilities/total assets and asset turnover ratio - NS/TA - net sales/total assets

Seventh level: the company's ROE index

The main goal of investing is to get the highest return. Investors are looking for criteria that will guide them in identifying investment returns. Accounting profit and its derivatives are among the criteria that have been presented and used to predict returns. In this study, a new measure called capital efficiency is presented. Capital efficiency is the ratio of added value to invested assets.

The main purpose of this research is the need to pay attention to the concept of capital efficiency in companies that are members of the Tehran Stock Exchange. According to the applied approach of the research for investors and managers to achieve a clear criterion for improvement in formulating investment strategy and stock selection, the investigated relationships have been done in order to investigate their predictive nature. The practical importance of

the impact of capital productivity on both value and growth strategies in the field of investment management is due to the fact that portfolio managers are often required to maintain the existing strategy of the company's portfolio (value or growth) based on the restrictions and policies written in their companies are and must move within its framework. Therefore, it is recommended to portfolio managers and market participants of Tehran Stock Exchange to pay attention to the factor of capital efficiency in any type of value and growth investment strategy. Also, the emphasis on capital efficiency, in addition to the higher future returns that it brings to investors, on the one hand, has the guidance for company managers that increasing capital efficiency is an important factor in increasing the real value of the company and effective in attracting funds. The need is from the capital market, and on the other hand, in macro dimensions, it brings the realization of increased economic growth through the improvement of capital efficiency (due to the narrowness of the concept of capital efficiency with production and operational added value in companies).

Step 3: Validation of capital efficiency model using confirmatory factor analysis method

In this step, the obtained final model is validated by path analysis method and the paths inside the final model are validated. The results show the appropriate fit of the proposed model. After testing the measurement models, it is now necessary to provide a structural model that shows the relationship between the research variables. Using the structural model, research hypotheses can be investigated. According to the path analysis diagram and the amount of significant coefficients, since the CR value (critical ratio) must be greater than 1.96 or less than -1.96 to reject or confirm the relationships, the value of the parameter between the two domains in the model is not considered important. Also, the values between these two values indicate that there is no significant difference in the value calculated for the regression weights with a value of zero at the 95% level. Therefore, all routes are approved.

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