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The effect of combined firm size index on improving corporate profitability models

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ABSTRACT

One of the internal factors of companies affecting their financial structure and profitability, is the firm size. Researchers have used various factors to measure the firm sizes in their research. Every factor has its own disadvantages and benefits; thus, the factors have different interpretations in financial affairs of the companies. By combining different factors, this study tries to propose a new concept of the firm size variable and provide a factor as a replacement for one variable, which includes the benefits of various factors, simultaneously. Different factors of firm size are evaluated in this article using exploratory factor analysis, and a new factor is derived from the principal components method and presented as the firm size variable. In order to investigate the impact of this factor on improving accounting models, its effects on profitability of firms have been tested. To this end, a sample set consisting of 139 firms are studied between 2009 and 2019. In this study, ROA and ROE are used as profitability indices. The results show that using factor analysis as an indicator of firm size, improves the profitability results for that firm, and firm profitability is improved, with significant differences, when a factor is used as the firm size index, compared to the case when an index is used for this purpose.

Keywords:

firm size, exploratory factor analysis, principal components method, profitability

1. Introduction

Firm size has an important role in determining the type of relations a company has inside and outside its operational environment and represents competitive superiority. Since gaining a bigger share of the market requires more production, sales and marketing; having sufficient financial resources and a larger size, may help a company to achieve this goal and create a competitive advantage (Gabbitas and Gretton, 2003). One of the most important indices in measuring the performance of companies is the profits of their operations and the shares of firms with higher profitability are favored by the market, and therefore studying and understanding profit behavior can help decision-makers to buy or sell corporate stocks, and in the meanwhile, the size of the company is regarded as an important factor reflecting the profit behavior of the corresponding firms (Ahadi Sarkani et al., 2013).

In corporate financial discussions, firm size is usually regarded and used as an important and fundamental feature of that firm. However, there is no article available in the existing literature that has performed a comprehensive sensitivity assessment on the experimental results obtained from corporate finances to different criteria of firm size (Changui, 2018). National and professional organizations and institutions in different countries have provided various definitions for small and medium sized business units, and different criteria are used to classify and separate these business units. These definitions and classifications, are based on criteria including the number of employees, sales amount, total sum of assets, capital and total transactions. However, due to the laws and regulations of countries and differences in different industries and economic sectors in terms of their nature, activities, and volume of transactions, the use of merely one criterion to define these units, does not seem appropriate (Rahimian, 2013).

The present study aims to present a new concept of firm size using empirical evidence and documents, that can include all features of the most widely used indices of firm size simultaneously, and to fill this gap by stating a new factor of firm size using factor analysis. This study, investigates the effects of using various representatives (total assets, total sales, and stock market value, etc.) on calculation of firm size. Different representatives, reflect different aspects of "firm size" and, as a result, have different interpretations in the context of corporate financial affairs.

In this research, firm size is investigated using exploratory factor analysis, and a new factor of firm size is derived based on the statistical population in question. To investigate the effects of the new factor in accounting models, the impact of this factor on profitability of firms is studied and those variables that have gained the required score and in factor analysis and have not been eliminated are tested. Finally, the optimal firm size index in profitability is determined.

Since size is one of the fundamental variables of companies, any small difference can provide a drastic effect on the dependent and other independent variables in the experimental study (Changui, 2018). The sensitivity of experimental results to various size criteria, not only guides researchers who should use firm size representatives in financial research, but also clarifies the future research for determining the effects of various representatives of a variable in other areas of research. This study seeks to answer this question: Does the new concept of firm size based on exploratory factor analysis have an impact on improving accounting models and in particular the profitability models of firms?

Theoretical foundations

There are three fields of categorization according to literature which act as the main determining factors of firm size namely, organizational, technological, and institutional theories (Kumar, Rajan, & Zingales, 1999). This categorization is subject to if the theory is based on the process of control, environmental influences, or production functions.

1) Organisational Theories

Organisational theories are split into contracting cost, transaction cost and the hierarchical nature of the firm. For the purposes of this paper, the focus will only be on contracting cost and transaction cost theories of the firm. Hierarchal theories of the firm delve into topics that cannot be tested by the data used in this paper, and therefore fall outside the scope of the current study. Organisational theories of economic literature focus on the nature of the costs of transactions in the market and within the firm itself as main determinants of firm size.

2) Contracting Cost Theories

Contracting cost theories of the firm begin with identifying the nature of the firm, stemming from

Coase's (1937) insight into the nature of the firm. Coase's first focus was to ascertain why a firm exists at all, and his insight was to realise that the firm itself has developed from the costs of transactions in the market. A firm will form when the costs of using the markets to form short-term contracts are higher than producing the good internally. The firm is based on a system of relationships in which it will expand this integration to the point where the marginal cost of an additional transaction equals the cost of carrying out the transaction through the market or another firm. Diminishing returns to transactions and organisation occur, resulting in decreasing efficiency as the size of the firm increases (Coase, 1937).

Alchian and Demsetz (1972) extended on this research by adding the mechanisms that elaborate on the reason for management of cost of resources remain low in a firm in comparison to these resources in the market's allocation. Firms are able to manufacture products efficiently compared to the market as

they specialize in producing certain products. According to Alchian and Demsetz (1972), in the long run, firms have developed better ways of optimising their production with high technology and current techniques and have garnered best practices of combining their resources and skills so that it's also cost efficient compared to the market.

3) Transaction Cost Theories

Coase's (1937) developed the transaction cost theory which suggests that costs incurred by the organization among firms do not amount to zero as the assumption made in the economy theory and in fact this should be taken into account when explaining the establishment of certain types of economic firms. The transaction cost theory for firms is not very different from the cost of coordination theory as described above; however, the concentration here is on internal costs of the companies as opposed to comparison of costs among firms. The transaction cost theory focuses on the impacts of the business operation's transaction costs especially in areas where investments were made to be relation-specific by the economic players (Verwaal & Donkers, 2002).

It is also noted by Alchian, Crawford and Klein (1978) that the development of transaction cost theory is still too simplistic to accurately portray the complicated real life business relationships. It must be asked what contracts work in which situations to understand the dynamics of transaction costs on firm behaviour. If this does occur, contracting cost theory will take on a very interesting element in terms of international trade.

4) Technological Theories

There are a few basic assumptions that are understood in the formation of technological theories in the firm; they are that the firm is a learning and adaptive organization that reacts to external shocks according to its goals and visions of reaching these goals (McConnell, 1979). The fundamental understanding in this theory is that the size of the firm is determined by the market's size. Additionally, it is understood that the focus is on the firm's specialization in that larger firms are supported by larger markets which in turn enhances their specialization. The individual employee's specialization is also then in proportion to the size of the firm proportional to firm size (Kumar et al., 1999).

5) Institutional Theories

According to Kumar, Rajan & Zingales (1999), institutional theories concentrate on the impacts of the environmental and institutional macroeconomic nature on the size of the firm. This part of the study is further divided into two sections that cover the regulatory and financial theories which act as hindrances to the firms. This theory acts hand-in-hand with the organizational and technological theories and together can assist in establishing a formidable theory in the formation firm's size.

According to studies, researchers have used different indicators for the firm size variable in their researches, each of which has its own advantages and disadvantages. A few of the most commonly used indicators of firm size are as follows:

Total firm assets: In most accounting researches, the amount of total assets at the beginning of the time period is used as the firm size indicator. Since assets are reported at the historical final cost, they are more objective and easily accessible (Panahi and Khosravi, 2008). The valuation of assets in the financial statements is equal to the final price minus the accumulated depreciation. The resulting net book values may be irrelevant to the present value of the asset (Wakil, 2019). Accordingly, the book value of the assets is less relevant due to accounting conservatism (Lara, 2014; Kang, 2017). Fixed assets are an important source for business and an important foundation for firm value and power and its earnings and can represent a significant amount of the firm

value in financial statements. Thus, some researchers have used the ratio of fixed to total assets as an indicator of firm size (Ahadi Sarkani et al., 2013).

Firm sales value: One of the most widely used indicators of firm size is the firm sales value. In other words, there exists a direct and positive relationship between sales and firm size (Tabari et al., 2015). Since the sales at each period are related to the same period, it will have a high degree of objectivity and relevance. Some researchers use the firm sales value as a criterion of the firm size (Masoumi and Sabetfar, 2011). One of the disadvantages of this index for firm size is the severe fluctuations in annual sales (Panahi and Khosravi, 2008). Abeyrathna (2019), tested the effect of firm size on companies' profitability in his research, and assumed the firm size index as the summation of total assets and total sales.

Firm market value: To determine firm sizes, some researchers calculate the total market value of firms' shares for each firm at a specific date. The total market value of the firm shares is calculated by multiplying the number of shares (the number of shares held by people) by the market value of each share of that firm in the stock exchange market. Kim and Bamier have used total firm value as an indicator of size. One of the disadvantages of this index is that the market value of a company may not reflect its real value in countries without efficient capital markets (Masoumi and Sabetfar, 2011; Panahi and Khosravi, 2008).

Non-executive board members: The work by Linck et al. (2008), is taken into consideration to investigate the structure of the board of directors, more specifically, the independence of the board of directors is investigated similar to the study by Linck et al (2008). This benchmark article, uses stock market value as an indicator of firm size. The ratio of non-executive members of the board of directors is defined as a dependent variable, and the positive sign of firm size indicates that large firms import more managers from outside the company.

The structure of the board of directors, has gained a lot of attention as an important issue in corporate governance; the existing articles in the literature cover three important characteristics of the board of directors: independence, i.e., the ratio of external directors (Weisbach (1988), Byrd & Hickman (1992), Brickley et al. (1994), etc.); size (Johnson (1993), Yermack (1996), Coles et al. (2008), etc.); and leadership, i.e., separation of the CEO and the chairman of the board of directors (Baliga et al. (1996), Brickley et al. (1997), etc.).

As mentioned above, each index has its own special advantages and disadvantages and it is not possible to use one index throughout the whole research. So far, the index with the least problems has been used considering the purpose of the researches. However, to determine size, a factor should be determined by combining various indicators, that contains the characteristics of all indicators simultaneously. Forbes Global 2000 uses four criteria (total assets, sales volume, net profit and capital market value) to rank all the world's largest companies, and Fortune 500 uses two criteria (sales and net profit) as well for the same purpose. Both organizations use sales and profits, however, the amount of profits is rarely used in academic papers as a measure of firm size. In addition, Heart and Ulten (1996) argue that net assets can be negative, while the sales are positive. They also point out that the number of employees does not include the number of part-time employees, however, part-time employees also play a very important role today. Different representatives of firm size, illustrate different aspects of "firm size" and thus, will have different interpretations in corporate finances. For instance, stock market value is more market-related and future-looking, therefore it only reflects stock ownership, while total assets measure the summation of firm resources. Total sales, are mostly related to the product market and do not consider the future. Past studies, provide contradictory results, regardless of the method used to determine the firm size.

Research background

Hashemi et al. (2020), studied the sensitivities of different firm size measurement methods on firm financial operations. Different indicators of firm size, including: total assets, summation of sales and capital market value and the number of employees were examined in that article. Data from Brazil, Russia, India, China, and South Africa where also analyzed. They evaluated the results based on R2 sensitivity. The results of this study show that various firm size indicators, have different relationships with financial operations of the company. The indicators represent different aspects of firm size and researchers must perform with utmost care when using each firm size

indicator. Furthermore, Hashemi et al. (2018) performed the same study on another statistical population for eight years, and their results were consistent with the abovementioned results.

In their study, Changui et al. (2018), examined the sensitivity of the results obtained from different firm size measurements to financial affairs. Three variables of total assets, total sales and total stock market value were used as firm size indicators in their research. This study showed that the results obtained by using different firm size variables, lead to different results in corporate financial matters.

Vijah and Yang (2013), provide a list of firm size representatives and the corresponding coefficients of firm size representatives in their articles. This list indicates that the sign and importance of firm size coefficients, in various articles, are sensitive to firm size criteria. While Vijah and Yang (2013), suggest that firm size criteria should receive more attention, they do not compare the results based on the same regression and do not investigate firm size criteria other than their target models in their numerous articles covering firm finances.

Banchuenvijit (2012) investigated the factors affecting corporate performances in Vietnam in his research and found a positive relationship between total sales as a firm size indicator and profitability, and a negative relationship between profitability and total assets. However, no significant relationship was observed between the number of employees and profitability.

Karadeniz et al. (2011), analyzed the variables affecting the yield on assets of firms in stock market exchange of Istanbul. The results of their study suggested that there exists a positive and significant relationship between the summation of assets as a firm size indicator and the yield on assets.

Atice et al. (1989), argued that the problem of variance heterogeneity can be resolved by preventing inflation of the regression equation using one variable. They believed this variable must be proportionate to error standard deviation. Since variances of errors can be dependent on firm sizes, conventional firm size variables have usually included total revenue from sales [Bior et al., 1982; Fauster, 1980], total assets [Fauster, 1977; Daley, 1984], stock book value [Bowen, 1981; and Beaver, Griffen and Landsman, 1982], and stock market value [Biddle & Lindhal, 1982; and Ball & Cutari, 1991].

For instance, Fauster (1977) and Daley (1984), used book value of firm assets as a firm size variable. Bowen (1981), used the book value of firm stocks at the beginning of the time interval as the variable indicating the firm size. Fauster (1980), used two variables for firm size: gross revenues and stock market value at the end of fiscal year. Beaver et al. (1982), used sales value and stock book value as indicators of firm size.

Nourbaksh et al. (2016) investigated the effect of different definitions of firm size on ranking firms and the suitability of fitting a causal model to liquidity. The results suggest that the rankings of firms with respect to their sizes, do not change significantly with a change in their size, however the definition of firm size based on sales genarates the lowest prediction error in the pattern of operational cash flow prediction.

Ahadi Sarkani et al. (2013), investigated the effect of firm size on profitability of firms accepted in Tehran Stock exchange. In this study, total assets and total sales, along with the ration of fixed assets to total assets were used as firm size indicators. Data from 135 companies for the period between 2001 to 2011 were analyzed. The results showed that there exists a positive relationship between firm size indicators and profitability.

Research methodology

This study is applicatory in terms of purpose, and post-event in terms of method. The research data are collected from the text of financial statements, explanatory notes, and monthly reports of stock exchange market using the databases of Rahavard Novin software as well as direct reference to financial statements of companies. The statistical population of this research includes all companies listed in Tehan's stock market during an eleven-years period from 2009 to 2019, that satisfy the following conditions simultaneously:

1) Accepted into Tehran's stock exchange market before March 19th, 2020.
2) The companies must be continuously active during the desired period and do not have any breaks longer than 6 months before the end of the fiscal year for a better evaluation of the market value.
3) They should not include other than financial institutions, enterprises and banks.
4) The data required must be available.

Due to the mentioned constraints, the research sample includes 139 companies. This study is performed in two steps: in the first step, the stages of determining the new factor of the firm size variable are investigated, while in the second step, the effects of the factor obtained from exploratory factor analysis on profitability of the firms are examined. In the first step, SPSS software is used to calculate the new factor using exploratory factor analysis, while Eview software is used for the analyses performed in the second step.

Research findings

Step one: deriving a new factor for firm size variable

The variables used in this section as representatives of firm size for factor analysis are as follows:

- Total assets
- Total sales
- Stock market value
- Percentage of non-executive shareholders: calculated from the ratio of non-executive shareholders in the board of directors to the total number of members in the board of directors.
- Ratio of fixed assets to total assets.

Factor analysis is used in this research. Factor analysis tries to identify the main variables or factors in order to explain the correlation pattern among the observed variables (Momeni et al., 1391). The factor analysis performed in this research is a exploratory analysis. Exploratory analysis, seeks to examine experimental data in order to discover and identify the indicators and the relationships among them, which is performed without imposing any specific model. In other words, in addition to having investigative or propositional values, exploratory analysis can also create structure maker, model and hypothesis.

The principal components method is used in factor analysis to extract all the factors. As can be seen from Table 1, the Kaiser-Meyer-Olkin sampling adequacy index, is calculated equal to 0.859 which shows that the data used in this research are reducible to fundamental and sub-fundamental factors and the sample volume is also adequate. Moreover, the result of Bartlett's test (3626.05) which is significant at the level of error equal to 0.001 shows that there is a good correlation between items within the factor.

Table 1: Sampling adequacy index and Bartlett's coefficient.

Kaiser-Meyer-Olkin (KMO) sampling adequacy index	0.859
Bartlett's test	3626.05
Degrees of freedom	10
Significance level	0.001

Table 2, which presents the commonalities, expresses two points:

1) The first column entitled "initial", shows the total variance value for each variable, explained using the set of various factors. Therefore, since the factors can explain all variances of one variable (100 percent), it can be seen from this table that the value of this variance is equal to number (1) for all items (variables).
2) The second column entitled "extraction" represents the amount of variance for each variable that the set of desired factors could explain. The value of this variance varies from (0) to (1). The closer the values are to one, the better, and the smaller values for each variable show that the variable in question is not adequately suitable for factor analysis, and it should therefore be excluded from the analysis. As a general rule, the variables for which the factors where not able to explain more than 5.0 (or 50 percent) of the fluctuations, are eliminated from the set of variables so that they do not cause problems in selecting and categorizing the factors later in the process.

In this study, based on the results of the second column of the following table, entitled "extractions", it can be realized that to what extent the set of the extracted factors were able to explain the changes in each item. For example, these factors were able to explain 56 percent of the variances of the variable "this year's sale".

Table 2. Commonalities for each variable.

Symbol	Variables	Initial	Extraction
x1	This year's sale	1	0.56
x2	Stock market value	1	0.66
x3	Total assets of the previous year	1	0.50
x4	non-executives to total ratio	1	0.52
x5	Fixed to total assets ratio	1	0.55
Extraction Method: Principal Component Analysis.			

The findings in the table above show that the commonalities of all variables are greater than 0.5; in other words, the set of factors under study were able to explain at least 50 percent of the variances for each variable.

The section in Table 3 entitled as "initial eigenvalues" corresponds to eigenvalues and specifies the factors remaining in the analysis (factors with eigenvalues less than 1 are excluded from the analysis). The factors eliminated from the analysis are those factors whose presence will not result in achieving higher values of variance. The results show that there exists one factor with an eigenvalue greater than 1 that remains in the analysis. In other words, the five variables are under the impact of one fundamental factor. This factor is capable of explaining approximately 60.58 percent of the initial five variables.

Table 3: Calculation of eigenvalues and the extracted variance percentages.

Initial Eigenvalues			factors
Cumulative percentage	Variance percentage	Eigenvalues	
60.58	60.58	2.50	1

Scree Plot

The contribution of each factor in the total variance is presented in the diagram below. In this diagram, the number of points with eigenvalues higher than one represent the number of factors. As seen from the figure, the first factor, with a variance equal to 60.58 percent and an eigenvalue equal to 2.5, makes up for the biggest part of the total variance.

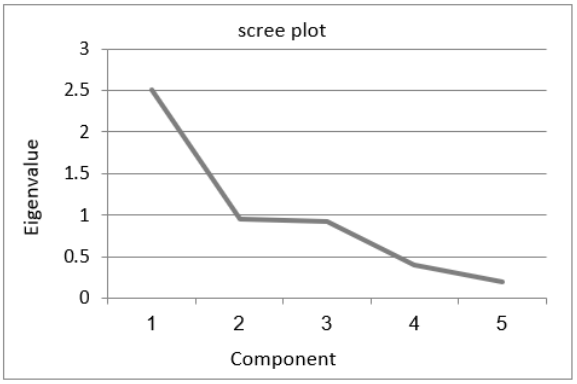

Figure 1. Share of each factor in total variance.

The rotated matrix

To rotate the factors matrix, the Varimax rotation method is used. Table 4 presents the rotated matrix of components which includes factor loads of each remaining variable after rotation. The variables that have a high component load in the components are presented. Variables with component loads less than 0.5 have been eliminated from Table 4 so that they do not reduce the validity of the structure.

Table 4. The identified factors, variables and factor loads (rotated factors matrix)

Symbol	Variables	Factor
x1	Total assets of the previous year	0.961
x2	Sales at current year	0.925
x3	Stock market value	0.847
x4	Ratio of fixed assets	0.021
x5	Ratio of non-executive members of board of directors	-0.034

The findings in the rotated table show that the three variables "total assets", "sales at current year", and "stock market value", have the highest component load in the components. The ratio of fixed assets and the ratio of non-executive members in the board of directors have gained the lowest factor load, and since their factor load is less than 0.5, they will be eliminated from the analysis.

The mathematical equation of the factor is as follows:

$$factor = 0.961x_1 + 0.925x_2 + 0.847x_3 + \varepsilon$$

where:

factor = firm size

x_1= total assets of the previous year

x_2= sales at current year
x_3= stock market value

step two: studying the effect of the derived factor from explanatory factor analysis in improving the ability to predict firms' profitability:

The main hypothesis of the research are as follows:

1) The concept of size based on exploratory factor analysis improves the ability to predict firms' profitability.

Sub-hypotheses include:

1) The concept of size based on exploratory factor analysis improves the ability to predict profitability based on ROA index.
2) The concept of size based on exploratory factor analysis improves the ability to predict profitability based on ROE index.

In this research, the effect of different firm size representatives on the ability to predict firm profitability is tested using the model introduced by Mesout Dougan (2013):

$$(PROFIT)ROA_{it} = \beta_1 + \beta_2 SIZE + \beta_3 LEV_{it} + \beta_4 LIQ_{it} + \beta_5 AGE_{it} + e_{it} \quad \text{Model (1)}$$

$$(PROFIT)ROE_{it} = \beta_1 + \beta_2 SIZE + \beta_3 LEV_{it} + \beta_4 LIQ_{it} + \beta_5 AGE_{it} + e_{it} \quad \text{Model (2)}$$

The dependent variables in this model include:

ROA: the yield of assets which is calculated from the ratio of net profits after tax to total assets.

ROE: the yield on stockholders' equity which is calculated as the ratio of the net profits after tax to total equity

Dependent variables include:

SIZE: corresponds to firm size. For the sake of our experiments the natural logarithm of summation of total assets, total sales, total stockholder equities and factors derived from factor analysis is used.

LEV: is a financial leverage obtained by dividing total debts by total assets.

LIQ: Liquidity calculated from the ratio of current assets to current liabilities.

AGE: represents the company's age

Table 5: The results of using various indices for firm size in model 1 are as follows:

Testing the relations among the variables		Adjusted coefficient of determination	Akaike coefficient	F statistic	Significance level	Durbin-Watson statistic
1) Use of total assets as the firm size index in profitability analysis of companies		0.667301	-2.710354	22.58264	0.0000	2.373787
2) Use of total sales as the firm size index in profitability analysis of companies		0.690030	-2.781117	24.95428	0.0000	2.334572
3) Use of market value as the firm size index in profitability analysis of companies		0.760343	-2.871145	24.60980	0.0000	2.443062
4) Use of factors from factor analysis as the firm size index in profitability analysis of companies		0.827144	-2.962571	25.00675	0.0000	2.363928
Comparison of different variables as the firm size index in profitability analysis of companies	$Asset_{it}$	0.667301	-2.710354	22.58264	0.0000	2.373787
	Sales	0.690030	-2.781117	24.95428	0.0000	2.334572
	Market_Value	0.760343	-2.871145	24.60980	0.0000	2.443062
	Factor	0.827144	-2.962571	25.00675	0.0000	2.363928

According to Table 5, the profitability has a considerable significance level in different firm size indices. Moreover, their Durbin-Watson statistic values are between 1.5 and 2.5. Among the profitability models, the model that uses the factor from factor analysis as firm size index, has a higher statistic F and adjusted coefficient of determination (0.82), and a lower Akaike coefficient (-2.962571). Therefore, the profitability model based on ROA index which uses the factor obtained from factor analysis as firm size index, has a higher efficiency and according to the results, the firm sizes based on Market_Value, Sales, and $ASSET_{it}$, are at the next ranks of profitability model based on ROA index, respectively. Therefore, different indicators of firm size result in different results for profitability model. Based on the results presented in Table 5, the factor from factor analysis, as firm size indicator, has the highest adjusted coefficient of determination in profitability

model with ROA index, followed by stock market value.

To investigate the significance of differences in adjusted coefficient of determination in the two models, Vuong test is performed on models 3 and 4 as follows:

Table 6. Results of Vuong test for models 3 and 4.

Vuong test for comparison between prediction capability of models 3 and 4			
Vuong test	**Type of statistic**	**Value of statistic**	**significance**
	Z	**-14.53643**	**0.0000**
Model	**Coefficient of determination**		
The model that uses capital market value (number 3)	0.760343		
The model that uses the factor obtained from factor analysis (number 4)	0.827144		

According to Table 6, the value of the statistic Z for models 3 and 4 is equal to -14.53643 with a significance level less than 0.05. Thus, the difference between the coefficients of determination of the two models is significant. Since the coefficient of determination of the firm size based on firm size factor is greater than the index based on total capital market value in the ROA profitability model, the firm size based on the factor obtained from factor analysis is more capable in profitability model based on ROA. Therefore, the factor from factor analysis and stock market value, as firm size indices, have significant differences in the ROA-based profitability model.

Table 7: The results of using different firm size indices in model 2 are as follows:

Testing the relations among the variables		**Adjusted coefficient of determination**	**Akaike coefficient**	**F statistic**	**Significance level**	**Durbin-Watson statistic**
1) Use of total assets as the firm size index in profitability analysis of companies		0.429755	-1.195327	9.109502	0.0000	2.394024
2) Use of total sales as the firm size index in profitability analysis of companies		0.446032	-1.224285	9.663944	0.0000	2.339284
3) Use of market value as the firm size index in profitability analysis of companies		0.674407	-1.257127	10.31247	0.0000	2.439515
4) Use of factors from factor analysis as the firm size index in profitability analysis of companies		0.753581	-1.623806	11.65461	0.0000	2.368788
Comparison of different variables as the firm size index in profitability analysis of companies	$Asset_{it}$	0.429755	-1.195327	9.109502	0.0000	2.394024
	Sales	0.446032	-1.224285	9.663944	0.0000	2.339284
	Market_Value	0.674407	-1.257127	10.31247	0.0000	2.439515
	Factor	0.753581	-1.623806	11.65461	0.0000	2.368788

As can be seen from Table 7, the profitability has a considerable significance level in different indicators of firm size. Moreover, the Durbin -Watson statistics are between 1.5 and 2.5. Among the profitability models under investigation, the profitability model with ROE index that uses the factor from factor analysis as firm size index, has a higher F statistic and adjusted coefficient of determination (0.7535), and a lower Akaike coefficient (-1.6238), followed by the firm sizes based on Market_Value, Sales, and $ASSET_{it}$, in prediction capability in the profitability model with the capital return index (ROE), respectively. Therefore, different indicators of firm size result in different results for the profitability model based on capital return. As seen from the results presented in Table 8, the factor from factor analysis, as firm size indicator, has the highest adjusted coefficient of determination in profitability model with ROE index, followed by stock market value. To investigate the significance of differences in adjusted coefficient of determination in these two models, the Vuong test is applied to models 3 and 4, as follows:

Table 8. The results of Vuong test on models 3 and 4.

Vuong test for comparison between prediction capability of models 3 and 4			
Vuong test	**Type of statistic**	**Value of statistic**	**significance**
	Z	**-86.55774**	**0.0000**
Model	**Coefficient of determination**		
The model that uses capital market value (number 3)	0.674407		
The model that uses the factor obtained from factor analysis (number 4)	0.753581		

To test the profitability model using Vuong's Z statistic, the obtained coefficients of determination are compared among the two models. As seen from Table 8, since the Vuong's significance coefficient is less than 0.05, the difference between the coefficients of determination of the two models is significant.

Since the coefficient of determination of the firm size based on factor on the ROE profitability model is greater than firm size based on capital market value on ROE profitability model, the firm size based on the factor obtained from factor analysis is more capable to explain the profitability model based on ROE. Therefore, at a confidence level of 95%, factor from factor analysis and stock market value are significantly different in ROE-based profitability models, as firm size indices.

Discussions and Conclusion

Using a fixed representative for different industries, different combinations of samples, different time periods, and/or selecting different indices as representatives of firm size, by different researchers, investigating the same research question, may be the reason for differences in the results obtained from the majority of previous studies in the literature (Changui, 2018). In this study, the variables corresponding to total assets, total sales, market value of stockholders' equity, the ratio of non-executive board members, and the fixed assets ratio are to obtain a factor as the firm size index, were studied simultaneously. In this study, different firm size representatives were investigated within two steps: in the first step, different representations of firm size were studied using exploratory factor analysis and firm size indicators were tested by analyzing the main components, and a firm size factor based on the combination of different representations of size variable was obtained, then in the second step, to investigate the effect of using the obtained factor of firm size, the ROA- and ROE-based profitability models were examined using factor analysis to test the impact of using one size indicator compared to firm size factor in the profitability prediction ability.

It is seen that all of the models under study have a considerable level of significance. Moreover, the Durbin-Watson statistic is between 1.5 and 2.5. Among the models under study, the model using the factor obtained from factor analysis, has higher values of F statistic and adjusted coefficient of determination and lower Akaike coefficient. Thus, the model that uses the factor from factor analysis as firm size, results in the improvement of profitability models and based on the results obtained from these models, the models wherein the capital market value, total sales and total assets are used as firm size indices, are at the next ranks in explaining profitability.

Thus, using different variables as firm size index in profitability models, provide different results.

According to the results, ROA and ROE profitability models, have higher adjusted coefficients of determination when the factor from factor analysis is used as firm size index. Since the stock market value index has the highest adjusted coefficient of determination after the factor from factor analysis, the significance of differences between factors of determination of the two profitability models while using these two indices (factor from factor analysis and stock market value) is investigated using Vuong's test. Since Vuong's significance coefficient is less than 0.05, the differences between the coefficients of determination of the two models with the highest values of coefficients are significant. Therefore, the use of the factor obtained from factor analysis as the representation of firm size in ROA- and ROE-based profitability models has the highest efficiency.

Considering the results, researchers are advised to use the factor obtained from factor analysis for firm size, instead of using a firm size index and thus benefit from the advantages of different firm size indices and cover the disadvantages of different indices, at the same time. Moreover, it is suggested that using factor analysis, variables in all domains with different indices to measure should be transformed into one factor, that

contains all characteristics of different factors, using factor analysis and then used in research and studies, because each index describes a specific aspect of that variable. In addition, for future works, the factor obtained for firm size index from factor analysis can be tested in other accounting models and the results can be compared in order to determine the best firm size index for other models. In the end, to expand the literature in this field in Iranian academic societies, the following suggestions are proposed for future works:

1) Examining the new concept of firm size in capital assets pricing models.
2) Examining the new concept of firm size in audit models.
3) Examining the new concept of firm size in management accounting analyses.
4) Proposing a new profitability index using factor analysis in accounting models.

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