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Industry financial ratios—application of factor analysis in Turkish construction industry

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Abstract

Turkish economy has been hit by various economical crises between the years 1998 and 2001 and the economic stagnation still continues. Past experiences in various countries show that it is vitally important to encourage construction activities in order to get out of stagnation, as construction output directly affects about 200 other sectors and industry financial ratio analysis is a means to provide a basis for the governments to undertake corrective action. However, there are over 50 financial ratios that can be used during analysis and some are more important than the others for different industries. Previous research has shown that there are about 25 factors that are important for the construction companies. This, in turn, requires elimination of unrelated data. Factor analysis is a data reduction and classification technique, which can be applied in financial analysis. Factor analysis was thus applied to the financial data collected from Turkish construction companies for a 5-year period in order to determine the financial indicators that can be used to analyse the financial trend of the industry. Five independent factors, i.e. liquidity, capital structure and profitability, activity efficiency, profit margin and growth, and assets structure were identified to be sensitive to the economical changes in the country. The results of the factor-based analysis can be used both by the government to analyse the changes in the industry with respect to time and by the construction companies to analyse their financial state with respect to their rivals.

Keywords: Financial industry analysis; Financial ratios; Construction industry; Turkish economy; Factor analysis

1. Introduction

The construction industry is an important contributor to the growth of any national economy and is directly affected by the government policies as governments usually regulate the economy by cutting back on public construction works during stagnation periods. Past experiences in various countries show that it is also vitally important to encourage construction activities in order to get out of stagnation as construction directly affects about 200 other sectors.

In this respect, the case of the Turkish construction industry is totally disappointing as the share of construction over GNP continuously decreased after numerous crises between the years 1998 and 2001. Thus, the government should analyse the financial state of the construction industry urgently and undertake related action.

Industry financial analysis is a means to provide a basis for the government to undertake corrective action and requires analysing a vast amount of data collected from financial statements of various companies within the industry. There are about 25 ratios that were reported to be important financial indicators for the construction industry in general (1–4,6). However, the importance of the ratios not only differs from industry to industry but also from country to country. Thus, the intention of this article is to present the results of the research with the aim of determining the most important

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indicators of the financial state of the Turkish construction industry.

2. Industry financial ratios

Financial statements like balance sheets and income accounts provide a vast amount of data related with the financial state of a company. These data, then, are simplified through financial ratio analysis, in order to understand and analyse the company's performance and financial state [1–6]. However, most ratios by themselves are not highly meaningful, unless they are compared with some standard, such as industry trends or yearly trends.

Industry financial ratios not only allow comparison of a company's financial performance with its rivals within the same industry, but also allow comparison of the industry itself over time. However, there are a vast amount of financial ratios that can be used during comparisons and some are more important than the others for different industries. This raises the issue of classifying financial ratios by reducing redundancies [6–8]. Three main approaches have been applied to the classification problem, where the latest research has largely focused on the inductive approach:

1. *Pragmatic approach*: Classification is based on the business practices and the personal views of the distinguished analysts.
2. *Deductive approach*: Classification is based on the technical relationship between the different ratios, and Du Pont financial control system is an example.
3. *Inductive approach*: Classification is based on statistical techniques like discriminant, logit/probit, recursive partitioning, cluster and factor analysis.

Whatever the classification approach, industry financial ratio analysis can tell much about that industry if combined with other knowledge of the industry. Thus, the relationship between the construction industry and the national economy is discussed below by focusing on the Turkish construction industry in particular.

3. Relationship between the construction industry and the national the economy—the state of the Turkish construction industry

The construction industry is an important supplier of any national economy and it is directly affected and very prone to the 'stop-go' policy of the governments, especially if the country is in the process of industrialisation [9,10]. This is mainly due to the fact that governments try to regulate the economy by cutting back on public spending, which means cutting back on construction activities. However, there is often a time delay between the operation of government policies and their effects upon the industry due to two main reasons [10].

1. There is a long lead time on contracts, often years, which is necessary for planning, design and tendering procedures to be completed (delays the effects of 'go' policies).
2. The low level of activities at the start and the finish of contracts, means that as many contracts may only just have started when the stop policy was applied by the government. These contracts will then blossom and hide the problem of depression for some months (delays the effects of the 'stop' policies).

Construction is related with about 200 sectors and thus considered as 'locomotive' as it leads the commercial activities within these sectors [11–12]. Thus, Britain in the 1950s, Germany after the Second World War and Malaysia in the early 2000s encouraged and supported construction activities in order to get out of economic stagnation, i.e. construction was used as the starting point of the 'go' policies. However, data in Table 1 [13] show that it has not been the case for the Turkish construction industry.

The Turkish economy was affected by the Asian and Russian crises in 1997 and 1998, respectively. The effects on the construction industry were observed in 1999 as the industry had a fundamental downsize. Two major earthquakes in the north-west region also affected construction output. Meanwhile, Turkey's acceptance of candidacy to the EU membership boosted the construction investment, which only continued until the end of 2000. In 2000, while infrastructure projects constituted 95% of the total projects, housing had only a 1% share. This was due to the government's ban on new private construction licences after the earthquakes in 1999. Devaluation of Turkish currency caused economical crises in the country in November 2000 and in February 2001 and affected all of the sectors seriously. Construction companies were additionally affected by the resulting stand-by agreement with the

Table 1
GNP growth vs. construction growth in Turkey

Year	GNP growth (%)	Construction growth (%)
1991–1998	4.5	5.4
1999	−6.4	−12.7
2000	6.1	5.8
2001	−9.4	−5.9
2002	7.9	−2
2003	5.4	−9
2004	9.9	4.6

International Monetary Found in 2001, which declared holding up the public tenders. While the Turkish economy started to recover after 2002, such a recovery was not observed for the construction industry. Share of construction activities, which accounted for an average of 6–7% before 1999, dropped to an average of 4.5% [11]. As discussed above, this was not only due to the fact that the Turkish government continuously cut the share of the construction investments, it was also because flat/house building construction, that has an important share of the total construction work, nearly stopped after 1999, mainly due to the effects of high inflation rates, high-bank credit rates for the house buyers, devaluation of the Turkish currency, and the government's ban on private construction licences.

4. Research material and methodology

Factor analysis was used to determine the relationship between various financial ratios and the financial state of the Turkish construction industry. Financial data were collected from the Istanbul Stock Exchange (ISE) traded construction companies (mainly main contractors) in order to get reliable information. However, this was restrictive in a sense that the latest financial data in the ISE 2004 database were for the year 2001. Thus, the period of 1997–2001 was adopted during the research as a '5-year period' was determined to be the best fit for yearly trend analysis of an industry [14]. This provided reliable information for 28 companies for the period of 1997–2001 during which the Turkish economy moved from a boost in 1997 to a crisis 2001. Collected data were then used to derive financial ratios that formed the basis for factor analysis.

4.1. Factor analysis

Factor analysis is a statistical method that is based on the correlation analysis of multi-variables. The purpose is to reduce multiple variables to a lesser number of underlying factors that are measured by the variables. Factors are formed by grouping the variables that have a correlation with each other [15]. Factor analysis is effective when the sample size is more than 300. There are mainly four stages in factor analysis [16]:

1. *Initial solution*: Variables are selected and an inter correlation matrix is generated for including all of the variables. An inter-correlation matrix is a $k \times k$ (where k equals the number of variables) array of the correlation coefficients of the variables with each other. When the degree of correlation between the variables is weak, it is not feasible for these variables to have a common factor, and a correlation between these variables is not studied. Kaiser–Meyer–Olkin (KMO) and Bartlett's tests of sphericity (BTS) are then applied to the studied variables in order to validate if the remaining variables are factorable. The KMO value should be greater than 0.5 for a satisfactory factor analysis. Table 2 explains the relationship between KMO values and the degree of common variance [17]. BTS, on the other hand, should show that the correlation matrix is not an identity matrix by giving a significance value smaller than 0.001.
2. *Extracting the factors*: An appropriate number of components (factors) is extracted from the correlation matrix based on the intial solution. In the initial solution, each variable is standardised to have a mean of 0.0 and a standard deviation of ± 1.0. Thus, the eigenvalue of the factor should be greater than or equal to 1.0, if it is to be extracted.
3. *Rotating the factors*: Sometimes one or more variables may load about the same on more than one factor, making the interpretation of the factors ambiguous. Thus, factors are rotated in order to clarify the relationship between the variables and the factors. While various methods can be used for factor rotation, the Varimax method is the most commonly used one.
4. *Naming the factors*: Results are then derived by analysing the factor load of each variable. Appropriate names are given to each factor by considering the factor loads.

Table 2
KMO values vs. degree of common variance

KMO value	Degree of common variance	Explanation
0.90–1.00	Marvellous	Factors will account for substantial amount of variance.
0.80–0.89	Meritorious	Factors will account for substantial amount of variance.
0.70–0.79	Middling	Factors will account for sufficient amount of variance.
0.60–0.69	Mediocre	Factors will account for sufficient amount of variance
0.50–0.59	Miserable	Factors will account for small amount of variance
0.00–0.49	Don't factor	Don't factor

5. Results and discussion

5.1. Initial solution

Previous work [6–8] has shown that selecting the variables and using market data are vitally important for the reliability of the factor analysis results. The Central Bank of the Republic of Turkey uses only 14 ratios as financial indicators for the Turkish construction industry. Refs. [2–4,6] additionally show 11 other ratios as important financial indicators for the construction industry. Thus, 25 financial ratios in Table 3 have been selected by combining these findings. Twenty-five financial ratios were then calculated for each company by using the collected financial data for the years between 1997 and 2001, and the correlation matrix was generated. Correlation matrix results showed that nine ratios (ratios between nos. 17 and 25 in Table 3) had a very weak correlation with the others and they did not have considerable explanation strength. These variables were therefore excluded from the analysis, leaving 16 ratios to be studied. Table 4 shows that KMO and BTS results were satisfactory for the data set of 16 ratios. KMO value, 0.675, meant that the degree of common variance among the 16 variables was 'mediocre,' and if a factor analysis was conducted, the factors extracted would account for a sufficient amount of variance.

Table 3
Financial ratios used for the initial solution

Variable no	Financial ratio
1	Current
2	Quick
3	Cash
4	Accounts receivable (short term)/total assets
5	Total debt
6	Current assets/total assets
7	Earnings before interest and taxes/interest
8	Return on assets
9	Earnings before taxes/net sales
10	Inventory turnover
11	Asset turnover
12	Working capital turnover
13	Long term assets turnover
14	Assets growth rate
15	Earnings before interest & taxes/net sales
16	Gross profit/net sales
17	Accounts receivable turnover
18	Earnings before taxes/equity
19	Net profit growth rate
20	Inventory/total assets
21	Short term debt/total debt
22	Long term assets (net)/equity
23	Equity turnover
24	Earnings before interest and taxes/net sales
25	Sales growth rate

Table 4
Kaiser–Meyer–Olkin and Bartlett'in test results

KMO	0.675
χ^2	2215.936
Degree of freedom	120.00
Significance	0.00

Table 5
Total variance explanation percentages of the components-unrotated values

Component (factor)	Eigenvalue (a)	Variance % ($a/16 \times 100$)	Cumulative variance %
1.000	5.542	34.635	34.635
2.000	2.711	16.941	51.576
3.000	2.093	13.079	64.655
4.000	1.830	11.435	76.090
5.000	1.283	8.020	84.109
6.000	0.663	4.144	88.254
7.000	0.447	2.791	91.045
8.000	0.374	2.338	93.383
9.000	0.303	1.894	95.276
10.000	0.242	1.512	96.788
11.000	0.176	1.102	97.890
12.000	0.134	0.836	98.726
13.000	0.075	0.466	99.192
14.000	0.059	0.371	99.563
15.000	0.053	0.329	99.892
16.000	0.017	0.108	100.000

5.2. Extracting and rotating the factors

Table 5 gives the initial solution values, i.e. unrotated factors. Eigenvalues showed that factors 1–5 would be extracted. The cumulative percentage of variance explained by these factors was 84.109%, meaning that a considerable amount of the common variance shared by the 16 variables could be accounted for by these five factors.

Factor values had to be rotated in order to interpret the solution set more easily. The comparison of the unrotated and rotated values in Table 5 and Table 6 shows that high correlations turned into maximum values while low correlations turned into minimum values. However, this did not affect the cumulative percentage (84.109%) of the variances and the ranking of the factors. The ranking showed that while factor 1 had the strongest effect in explaining the financial state of a company, factor 5 had the weakest.

5.3. Naming the factors

Factors were named by considering what their variables had in common (Table 7). The following names were given:

1. Factor 1, which had the strongest variation explanation level, included four ratios that had strong factor

loads. All the four ratios provided information on the companies' abilities to meet their short-term financial obligations without selling their inventories (Table 7). Thus, the factor was named as 'Liquidity Factor'.
2. Factor 2 included ratios that measured both the long-term solvency and the effectiveness of the companies in using their assets to generate profits. While return on assets and earnings before taxes over net sales had positive factor loads (0.900 and 0.764, respectively), debt ratio had a strong negative factor load (−0.905) meaning that when the debts over the assets increase, the profitability of a company should decrease. This factor was named as 'Capital Structure and Profitability Factor'.
3. Factor 3, which was named as 'Activity Efficiency Factor,' included the ratios that measured the companies' efficiencies in using their working capital, assets, and inventories. Factor load of 0.536 in Table 7 shows that inventory turnover was not as influential for construction companies as working capital turnover and assets turnover.
4. Factor 4 included ratios that measured the success of the companies in growing and generating profits. Ratios within this factor were related with the operating earnings and excluded interests and taxes and are thus named as 'Profit Margin and Growth Factor'.
5. Factor 5, which had the weakest effect on explaining the financial state of the companies, included two ratios that measured the proportion of the assets and the accounts that might be converted into cash within a year over total assets. This factor was related with the ability of the companies to fund their ongoing day-to-day activities and was named as 'Assets Structure Factor'.

Table 6
Total variance explanation percentages of the components-rotated values

Component (factor)	Eigenvalue (a)	Variance % ($a/16 \times 100$)	Cumulative variance %
1.000	3.660	22.874	22.874
2.000	3.068	19.175	42.048
3.000	2.428	15.174	57.223
4.000	2.274	14.210	71..433
5.000	2.028	12.677	84.109

5.4. Validation of the results

In order to validate the factor analysis results, statistical analysis was undertaken to show the relationship between the economical state of the country and the value of the factors between the years 1997 and 2001. This was achieved by comparing the mean and the standard deviation values of each factor for each year. The mean and the standard deviation values were based on the factor score values of the companies. To give an example, Table 8 shows the liquidity factor score values of each company and the resultant mean and standard deviation values for the industry. It was observed from the similar tables used during the calculations of the remaining four factors that factor scores did not only provide important data to evaluate the overall performance of the industry, but were additionally important for the individual companies to analyse the financial position of themselves with respect to their rivals.

Fig. 1 shows the mean and the standard deviation values for the liquidity factor scores for 28 construction companies. While the mean value increases between

Table 7
Component matrix

Variable (financial ratio)	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5[a]
Quick	0.920				
Cash	0.919				
Earnings before interest & taxes/interest	0.883				
Current	0.852				
Debt		−0.905			
Return on assets		0.900			
Earnings before taxes/net sales		0.764			
Working capital turnover			0.921		
Asset turnover			0.844		
Long term assets turnover			0.617		
Inventory turnover			0.536		
Earnings before interest and taxes/net sales				0.899	
Gross profit/net sales				0.858	
Assets growth rate				0.500	
Accounts receivable/total assets					0.893
Current assets/total assets					0.886

[a]Name of the factors: Factor 1: liquidity, Factor 2: capital structure and profitability, Factor 3: activity efficiency, Factor 4: profit margin and growth, Factor 5: assets structure.

Table 8
Liquidity factor scores of each company

Company	Factor score				
	1997	1998	1999	2000	2001
S1	1.010	1.499	1.405	0.641	0.242
S2	−0.631	0.653	0.071	−0.172	−0.301
S3	−0.667	−0.736	−0.881	−0.161	−0.259
S4	0.852	−0.072	−0.537	0.273	0.267
S5	−0.608	−0.308	−0.121	0.724	0.829
S6	−0.465	−0.283	−0.388	−0.399	−0.489
S7	−0.655	−0.391	−0.660	−0.720	0.550
S8	0.051	−0.332	−0.223	−0.250	−0.282
S9	−0.561	−0.577	−0.136	−0.113	0.147
S10	0.170	0.254	0.892	0.219	0.036
S11	−0.362	−0.189	−0.069	0.065	−0.112
S12	−0.624	−0.659	−0.520	−0.405	−0.314
S13	−0.558	−0.214	−0.380	−0.371	−0.224
S14	−0.313	−0.594	−0.525	−0.659	−0.526
S15	−0.313	−0.400	−0.200	−0.336	−0.380
S16	−0.444	−0.275	−0.192	−0.267	−0.390
S17	−0.419	−0.550	−0.131	−0.500	−0.629
S18	−0.193	−0.174	0.038	−0.020	0.076
S19	−0.267	−0.296	−0.298	−0.380	−0.413
S20	−0.119	−0.233	−0.511	−0.395	−0.637
S21	0.453	−0.194	0.084	0.003	−0.221
S22	0.449	1.487	0.959	0.868	−0.468
S23	0.455	−0.098	−0.334	−0.147	−0.237
S24	0.176	0.408	0.791	0.663	0.908
S25	−0.071	1.441	0.165	−0.137	−0.124
S26	−0.266	−0.385	−0.399	−0.498	−0.419
S27	−0.103	−0.273	−0.357	0.211	0.223
S28	0.361	0.962	1.101	1.315	0.641
Mean	−0.131	−0.019	0.273	−0.034	−0.089
Standard deviation	0.466	0.646	1.996	0.493	0.426

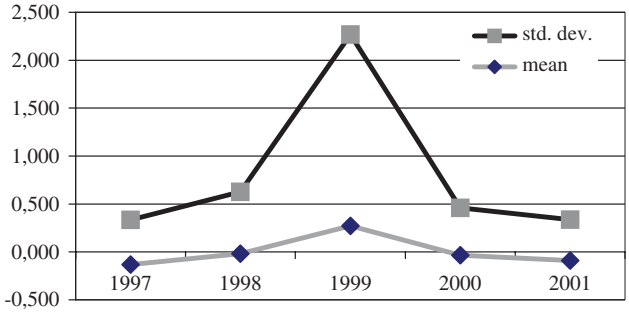

Fig. 1. Liquidity factor scores.

1997 and 1999, it starts to drop after 1999 (between 2000 and 2001) parallel with the changing economical conditions of the country. However, it is observed that the variation coefficient value (that is the ratio between standard deviation and the mean) is exceptionally high during 1999, showing that not every company in the industry was affected by the economical changes in the same direction. While the liquidity weakened for some companies, it improved for the others significantly. This was not an unexpected result, as while reconstruction after the earthquakes meant new opportunities for some of the largest companies, government's ban on new construction licences represented a threat for the companies which specialized in housing.

Fig. 2 shows that profitability factor values for the construction companies had a downward trend after 1997. However, an upward movement is noticed during the year 2000, which is a result of the construction growth. Fig. 2 additionally shows that although the mean and the standard deviation values have similar trends between the years 1997 and 2000, there is a rapid fall downwards for the mean value and a rapid move upwards for the standard deviation value in 2001. The deviation shows the effects of the crisis in February 2001, during which Turkish currency lost its value dramatically against the other currencies. This resulted in lower values of earnings before taxes and/or net earnings and higher debt ratios and in turn in lower profitability factor values due to the higher financial costs debt ratios for the companies that had debts in foreign currencies and vice versa.

Fig. 3 shows that the mean value of the activity efficiency factor continuously decreases after 1997. This means that it continuously got more difficult for the companies to sell their assets and to turn them into new investments. This has not been the case only for the construction companies but even for the ordinary people as people/companies tended to invest in foreign currencies or take the advantage of high interest rates, which have been considered as the least risky way to protect the value of their investments against devaluation of the currency or the persistent inflation in the country. Positive economical indicators like in the year 2000 did not last long to turn this trend over.

Profit margin and growth factor include the ratios that measure the companies' success in growing and generating profits. Ratios within this factor are related with the operating earnings and exclude interests and taxes. Thus, activities like firing workers or reducing

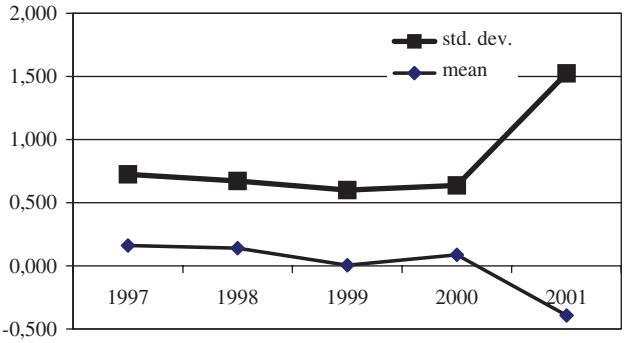

Fig. 2. Capital structure and profitability factor scores.

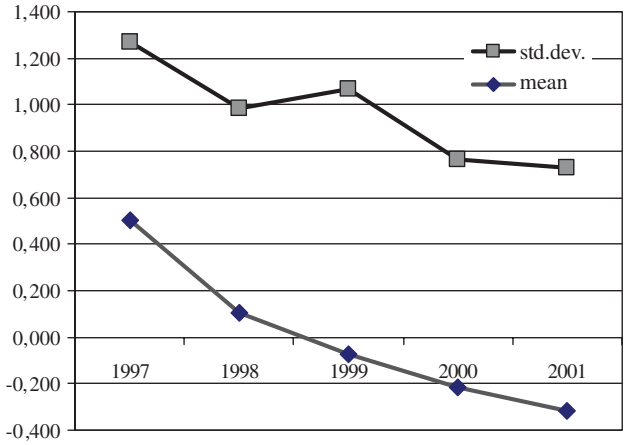

Fig. 3. Activity efficiency factor scores.

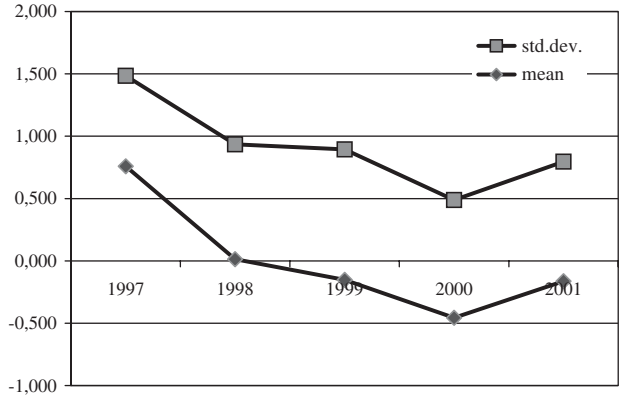

Fig. 4. Profit margin and growth factor scores.

overheads due to an economical crisis directly decrease operating costs and inevitably affect the profit margins. So, it is not surprising to observe that the mean value of this factor increases between 2000 and 2001 (Fig. 4).

The report published by the Union of Chambers and the Exchange Commodities in Turkey [17] states that the debt of the state to construction companies has been increasing continuously since the early 1990s. Fig. 5 shows the subsequent effect on the assets structure factor between 1997 and 2000. The factor value is directly affected by the receivable short-term accounts and the value between 1997 and 2000 increases as the amount of unpaid interim payments by the state to the companies increase. However, the rapid fall of the factor in 2001 does not mean that the value of the receivable short-term accounts decreased during that year. The catastrophic effect of the devaluation of the currency affected the asset structure factor by affecting the amount of the company assets as the companies had to sell their assets in order to get over the crisis.

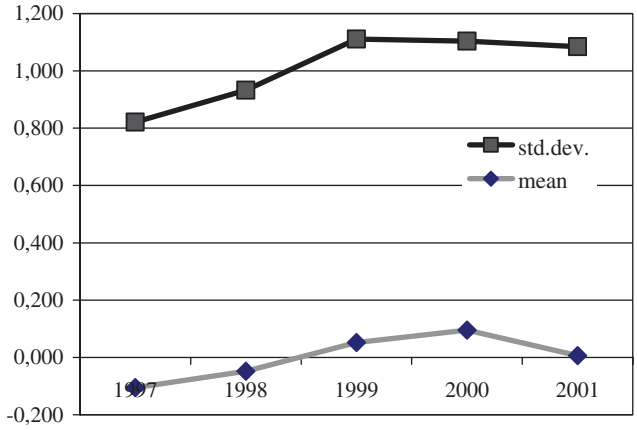

Fig. 5. Assets structure factor scores.

6. Conclusions and recommendations for further research

Encouraging construction activities is significantly important to get out of any economical stagnation in any country. Meanwhile, in order to start any action a realistic and continuous review of the industry is a necessity. Industry financial ratio analysis is a means to overview the financial state of an industry. However, there are quite a number of financial ratios that are more important than the others for different industries. Thus, the aim of this research was to determine the financial indicators that could be used to analyse the financial state of the Turkish construction industry. To achieve this, factor analysis was applied to financial data collected from Turkish construction companies. Five independent factors were identified and these appeared to measure liquidity, capital structure and profitability, activity efficiency, profit margin and growth, and assets structure of companies and proved to be sensitive to economical changes in the country. It was proved that continuous analysis of these five factors would provide sufficient information related with both the relative state of the industry with respect to time and the relative state of any construction company with respect to their rivals. While the focus of the current research was related with the interaction of the determined financial factors with the industry-based changes, it is evident that financial factors are directly affected by the organizational changes. It should thus be pointed out that research that focuses on individual company analysis should also include the effects of organizational (i.e. structural, managerial) changes to financial factors.

Although, the Central Bank of the Republic of Turkey has recently started a comprehensive research related with the financial analysis of the Turkish construction industry, the literature shows no previous research or practical application of financial ratio analysis in the industry. Thus, the results of the current

research will be a point of reference for further research and business applications. Meanwhile, further research may focus on the financial analysis of sub-sectors like housing or public works, which would then show the differences between the sub-sectors and guide the government bodies in determining their priorities. Related research may also be taken further by developing an early warning system of crisis for the construction companies. However, development of a realistic system would require the use of adequate and active (monthly or at worst quarterly) financial data, as the financial state of construction companies depends on the project-based variables which may change in short periods of time. Continuous review of both the industry and the company itself by the use of such an early warning system would enable the contractors to foresee the sources (industry based or organisational) of a potential crisis and take corrective actions accordingly.

Turkey accepted as a lower-middle income developing country in the World Bank classifications, is a good representative of developing countries and, thus, five factors determined during this research will present a point of reference for the financial analysis of construction industries, especially in developing countries.

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