**Artículo de investigación**

# Identification of criteria effective in financial performance (fp) of iranian petrochemical companies

Identificación de criterios efectivos en desempeño financiero (fp) de compañías petroquímicas iraníes

Identificação de critérios eficazes no desempenho financeiro (fp) de empresas petroquímicas iranianas

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## Abstract

This study was conducted to identify the factors effective in FP of the petrochemical companies in the stock market. The study was descriptive and causal-comparative conducted using fuzzy technique. The sample size was nine experts in the petrochemical industry with full command over the preparation of financial statements and offering reports on the preparation of the minutes of financial statements and financial ratios. They also had a high ability in analysis of financial statements to gain more profit or to reduce the related costs. The result of the interview with these experts was the identification of the six main indices: investment with a weighted average of 0.372 ranked first, and operational costs of the company with a weighted average of 0.185 ranked the second, operational costs on equity with a weighted average of 0.121 ranked third, ROA with a weighted average of 0.111 ranked fourth, ROE with a weighted average of 0.108 ranked fifth rank, P/E with a weighted average of 0.103 ranked sixth.

**Keywords:** Effective criteria, FP evaluation, Iran Petrochemical Industries, Fuzzy Technique[32]

## Resumen

Este estudio se utilizó para identificar los factores efectivos en el FP de las empresas petroquímicas en el mercado de mercado. El estudio fue descriptivo y causal-comparativo de uso de la técnica de fuzzy. La muestra fue un experto experto en la industria petroquímica con un completo comando sobre la preparación de las declaraciones de responsabilidad y los informes de la preparación de los minutos de las declaraciones financieras y las ratificaciones. También han tenido una alta capacidad en el análisis de las declaraciones financieras para obtener más beneficios o reducir los costes de los productos. El resultado de la entrevista con estos expertos fue la identificación de los seis principales índices: investment con una ponderación promedio de 0.372 en primer lugar, y los costes operativos de la empresa con una media ponderada de 0.185, el segundo, de acuerdo con el nivel medio de 0.121 de tercero, ROA con una ponderación promedio de 0.111 de cuarto de cuarto, ROE con una ponderación promedio de 0.108 rango de rango, P / E con una media ponderada de 0.103 anuncio sexto.

**Palabras clave:** Criterios de eficiencia, FP evaluación, Iran Petrochemical Industries, Fuzzy Technique

## Resumo

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Este estudo foi realizado para identificar os fatores efetivos em FP das empresas petroquímicas no mercado de ações. O estudo foi descritivo e causal-comparativo, realizado por meio da técnica fuzzy. O tamanho da amostra foi de nove especialistas da indústria petroquímica, com total controle sobre a elaboração de demonstrações contábeis e relatórios sobre a elaboração das atas das demonstrações contábeis e índices financeiros. Eles também tinham uma alta capacidade de análise das demonstrações financeiras para obter mais lucros ou reduzir os custos relacionados. O resultado da entrevista com esses especialistas foi a identificação dos seis principais índices: o investimento com uma média ponderada de 0,372 ficou em primeiro lugar, e os custos operacionais da empresa com uma média ponderada de 0,185 classificaram o segundo, custos operacionais com um média de 0,121 ficou em terceiro lugar, ROA com média ponderada de 0,111 ficou em quarto lugar, ROE com média ponderada de 0,108 em quinto lugar, P/E com média ponderada de 0,103 em sexto lugar.

**Palavras-chave:** Critérios eficazes, avaliação de PF, Indústrias Petroquímicas do Irã, Técnica Fuzzy.

## Introduction

In today's competitive world, all commercial companies, which have set their purpose to gain profit by presence at large domestic and global markets, realize that by attracting investors in financial markets, they will gain more profit through various ways, such as reduced costs, increased quality, followed by increased sales and so on.

Nowadays, one of the most important financial issues of companies is measuring their performance. How much companies have struggled to raise the interests of their stakeholders? What indices do the banks and credit institutions consider in granting loans to companies? What aspects do the owners of the companies consider in paying bonuses to mangers? Ultimately, what issues the government authorities take into account regarding the legal requirements in relation to companies can be adequately addressed by firms' performance evaluation methods (Keshtkar., 2013).

Hence, evaluation of the performance of companies is among the most important issues of interest to investors, creditors, managers and governments.

Performance evaluation is a process assisting the shareholders and other investors to make optimal investment decisions. Investors are also interested in finding out how much value is created from the investment made (Aleksandrovna Maximova and Aleksandrovich Belyaev, 2017)

In a general classification, the measures of performance evaluation can be divided into two groups of financial and non-financial criteria. Non-financial criteria include manufacturing, marketing, administrative and social criteria, and financial ratios are among the techniques proposed as financial measures. Some financial researchers have suggested using a combination of the indices (financial and non-financial). However, these criteria are troublemaking too since it is not easy to determine the type of criteria, the type of correlation between them, and the determination of the value and weight of each of them in a whole set of criteria (Keshtkar., 2013).

In Iran's oil industry, investment is one of the most important factors for development and, consequently, economic development of the country. The oil industry, as the main driver of the country's economy, has very high potentials and somewhat actual capabilities in accelerating Iran's economic growth and promoting the country's role in the international arena. Certainly, to promote the performance and productivity of the country's oil industry and to boost the national economy, by identifying major challenges faced by the oil industry at various levels of management and operation, one can take a great step to improve the level of performance of the Ministry of Oil and consequently to accelerate the economic development of the country.

Given the natural drop in the production of the country's crude oil due to the entry of most of the country's oil fields into the second half of their lives and their natural pressure drop, the need to increase the current production capacity of the country to maintain the current position in OPEC, stabilizing the privileged position in the international policy arena, and attracting financial resources to invest in diverse oil industry projects are of significant importance. Moreover, achievement of the objectives of the outlook of

the Islamic Republic of Iran in the oil, gas and petrochemical sectors also requires major investments in this industry (Hashemian Isfahani et al., 2008). The limitations of access to international financial resources and the limitations of the domestic financial resources of the oil industry for investment, which are mainly the plans and projects of the oil industry due to the rise in world prices in recent years, reduced share of income of the National Iranian Oil Company from the value of crude oil production and consequently, inability to use it in its developmental projects, and the country's legal issues in the oil and gas sector, which have made it possible to use only financial and buy back methods for the use of foreign funds are of the main challenges of the oil industry in financing projects. Moreover, the effects of sanctions and international pressures also limit the attraction of foreign investment in the country's oil industry. Thus, according to the experts in the oil industry, in the financial sector, the problem of financing oil industry projects is one of the main challenges the industry faces. Here, the necessity of identifying the factors affecting performance appraisal and providing innovative ways to attract foreign investors, as well as directing domestic capital to the oil and gas sector is badly felt (Brunner and Ganga-Contreras, 2017).

The importance of the petrochemical industry in the national economy is clear to everyone. One of the important advantages of the petrochemical industry is the supply of raw materials inside the country. Iran's petrochemical industry has achieved great success in recent years in producing conventional and basic petrochemical products. In this regard, the private sector and owners of capital and thoughts in production can assume many activities in the field of downstream industries, and give proper activity to the growth and development of downstream industries. However, it is necessary to think of strategies and solutions to maximize potential capacity in the complementary industries, which will result in industrial and economic development for Iran. Thus, managing the investment of the National Petrochemical Company, as one of the main managements of the company, has been established and organized with the purpose of attracting investment, partnerships and financing of projects under implementation by the Iranian petrochemical industry. In this management, identification and introduction of investment opportunities, the process of delegating projects to qualified investors and facilitating the

investment path are among the most important goals. In this regard, managing domestic and foreign partnerships through evaluating the technical and economic potential of investors, supporting investment attraction processes, supporting current investment funds, and creating new investment funds in line with the goals of the National Petrochemical Company are among other goals of this management (Informational Site of Petrochemicals Employers Association).

According to the abovementioned point the question is what the effective factors in evaluating FP of Iranian petrochemical companies are.

The results of Safai Gadikalayi et al. (2015) in evaluating performance indices of Damdoushan Alasht Company using the combination of Balanced Score Card (BSC) and Fuzzy Multiple Criteria Decision Making (FMCDM) showed that the best performance dimensions of Damdoushan Company were in customer and financial ones and the worst performance dimensions were, respectively, internal process, learning and growth. The results of Bahador, and Keshtkar (2017) in presenting and applying a new approach for stock screening based on the decision-making and multi-criteria optimization approach showed that this approach avoids paying attention to inappropriate companies, i.e. the companies whose market successes are based on cases such as rumors and false information. The proposed approach is recommended to those individuals who prefer to invest in stocks of the companies whose close FP of the last year and market success of the current year has been proven.

**Research objectives (including scientific, applied and the necessity of conducting the study):**

Identification of the criteria affecting FP of Iran's petrochemical companies and identification of a strategic plan for solving the financial challenges of Iran's petrochemical companies are of the main objectives of the research. Furthermore, the results can be used by the Iranian oil and gas industry, petrochemical industry, students and so on.

This research is applied regarding the purpose as identification of the factors affecting the performance of firms has long been an important issue.

**Research Process:**

In recent years, multi-criteria decision-making techniques have been among the highly effective techniques for identification of the factors affecting performance evaluation. These techniques have been the focus of the attention given their ability to select the best option from among several possible options based on performance indices and also their capabilities to assist decision making in fuzzy conditions along with uncertainty and based on unreal and subjective data (Keshtkar, and Ghazanfari, 2017).

FP of the companies studied is evaluated based on (traditional) accounting criteria and value-based criteria.

Accounting-based criteria are based on historical information and emphasize profit and loss and balance sheets. Given the views of financial experts, this study uses four criteria for evaluation of the FP of the companies: return on assets (ROA), return on equity (ROE), operating profit growth (OPG), and price/earnings ratio (P/E).

According to available data and audited financial statements, from among 55 projects

**Statistical inferences:**

approved by the Petrochemical Complex of Iran, from active, semi-active or non-active petrochemical complexes, 6 active companies active in Iran's petrochemical industries - Maroon, Abadan, Shazand, Amir Kabir, Khorasan and Shiraz - were selected to be studied.

Information and data were collected from library studies, balance sheets, financial statements and auditing, and the Internet.

In this study, using experts' opinions, some questions were designed which were numbered in two 5-option Likert scale formats as very high, high, average, low and very low and scored, respectively, from five to one. The second questionnaire was of preferred type used for performing Fuzzy AHP and AHP calculations.

The method regarding data collection was descriptive-survey method because the topics and data have been extracted from valid journals and libraries, balance sheets, financial statements and auditing, and the Internet. Information and data were collected from library studies, balance sheets, financial statements and audits, and also the Internet.

**• Validity and reliability of questionnaires**

As the questions of the study were based on the opinions of experts in financial affairs and experts in financial statements analysis, the questionnaire had no problems regarding validity. Moreover, Cronbach's alpha method was used to evaluate the reliability of the questionnaires, whose results are shown in the following table (Extracted from Spss 22).

*Table 2:* The number of questions and the reliability of the questionnaires - Spss output

| Row | Questionnaire | The number of questions | Sample size | Cronbach's alpha |
|---|---|---|---|---|
| 1 | **FP evaluation** | **6** | **9** | **82.3** |

**Descriptive table of sample financial experts:**

*Table 1*: Descriptive table of financial experts

| variable | Index | Number/amount |
|---|---|---|
| **Gender (percent)** | Man | 78 |
| | Women | 22 |
| **Professional history of experts (Year)** | 6-10 | 4 |
| | 11-15 | 2 |
| | 16-20 | 3 |
| **Level of education** | MA/MS | 6 |
| | PhD | 3 |

## Results

As the sample data were abnormal in the previous section, non-parametric methods should be used. In normal case, single sample Student t-test is used to test the effect or the lack of effect of effective factors on the implementation of organizational strategies, whose equivalent in non-parametric tests is chi square test. Thus, the data were entered into Spss, whose results are shown in the table below for the main indices.

*Table 3*: Factors affecting the FP of petrochemical companies

| Row | Questions | Degrees of freedom | Chi square | Sig. |
|---|---|---|---|---|
| 1 | Operational costs have an effect on financial performance. | 2 | 44.32 | 000 |
| 2 | Investment affects the firm's financial performance. | 2 | 48.51 | 000 |
| 3 | Based on the financial performance of petrochemical companies, P/E financial variable has an impact on equity (capital per day). | 2 | 65.21 | 000 |
| 4 | Based on the financial performance of petrochemical companies, ROE has an impact on equity (capital per day). | 2 | 51.42 | 000 |
| 5 | Based on the financial performance of petrochemical companies, ROA has an impact on equity (capital per day). | 2 | 48.47 | 000 |
| 6 | Based on the financial performance of petrochemical companies, operational costs affect equity (capital per day). | 2 | 48.51 | 000 |

**Explanation:** as the significance level is zero in all of the main factors and this value is less than 0.05, the null hypothesis, which the failure of the above factors is rejected, and the alternative hypothesis - the researcher's claim is confirmed that the above mentioned factors have an effect on the FP of petrochemical companies.

### How is the prioritization of the factors affecting FP of petrochemical companies?

In answering this question, first each index is written in a table and in the next step, the average of the answers of the experts is written in the tables, and at the final stage, the weight of the item, sub-indices, indices, and their charts are written and their charts are displayed based on prioritization. For example, we show entering the means of experts' answers in the Express Choice software (by AHP method).

❖   **Ranking of the questions of evaluation of FP of petrochemical companies**

*Table 4:* The means of responses of the experts

| Row | Variables | Operating costs of the company | Investment | P / E | ROE | ROA | Operating costs on equity |
|---|---|---|---|---|---|---|---|
| 1 | Operating costs of the company | | 3.56 | 2.18 | 2.36 | 2.59 | 1.22 |
| 2 | Investment | | | 3.26 | 2.56 | 2.63 | 3.18 |
| 3 | P / E | | | | 1.05 | 1.07 | 1.1 |
| 4 | ROE | | | | | 1.11 | 1.09 |
| 5 | ROA | | | | | | 1.13 |
| 6 | Operating costs on equity | | | | | | |

❖ **Calculating the weight of sub-indices and its ranking chart**

Note: According to the output, in all calculations performed by Expert choice, the degree of

*Table 5:* Weighted average and prioritization, output of Expert Choice software

| Row | Sub-index | Weighted average | Priority |
|---|---|---|---|
| 1 | Operating costs of the company | 0.185 | Second |
| 2 | Investment | 0.372 | First |
| 3 | P / E | 0.103 | Sixth |
| 4 | ROE | 0.108 | Fifth |
| 5 | ROA | 0.111 | Fourth |
| 6 | Operating costs on equity | 0.121 | Third |

inconsistency is 0.04, which is less than 0.1, so the accuracy of the calculations is confirmed.

❖ **Testing the hypotheses**

*Table 6:* The results of hypothesis testing- SPSS output

| Row | Test title | Sample size | Mean | Chi square | sig | Test result |
|---|---|---|---|---|---|---|
| 1 | Operational costs have an effect on financial performance. | 9 | 4.05 | 44.32 | 0.001 | Confirmed |
| 2 | Investment affects the firm's financial performance. | 9 | 4.54 | 48.51 | 0.001 | Confirmed |
| 3 | Based on the financial performance of petrochemical companies, P/E financial variable has an impact on equity (capital per day). | 9 | 3.87 | 65.21 | 0.001 | Confirmed |
| 4 | Based on the financial performance of petrochemical companies, ROE has an impact on equity (capital per day). | 9 | 4.07 | 51.42 | 0.001 | Confirmed |
| 5 | Based on the financial performance of petrochemical companies, ROA has an impact on equity (capital per day). | 9 | 4.08 | 48.47 | 0.001 | Confirmed |
| 6 | Based on the financial performance of petrochemical companies, operational costs affect equity (capital per day). | 9 | 3.94 | 51.50 | 0.001 | Confirmed |

**Table: Prioritization by Fuzzy AHP**

**Explanation:** given chi square test statistic, all values larger than the critical point 1.96 and sig=0 is less than 0.05, so the null hypothesis denoting the lack of effectiveness of the above factors is rejected and the alternative hypothesis denoting the effectiveness of the above factors is confirmed.

❖ **Evaluation of FP of 6 petrochemical companies based on product sales and profitability índices**

Considering the above, in the graphs ahead, the financial indices of sales and services and products and operating profit will be shown for the period 2013-2015, and according to the charts, we will see the FP of these companies in these three years.

**Evaluation of the financial index of sales and services of petrochemical companies**
The table below shows the sales of services and products of six petrochemical companies.

*Table 8:* Financial index of sales and services of petrochemical companies (Rials)

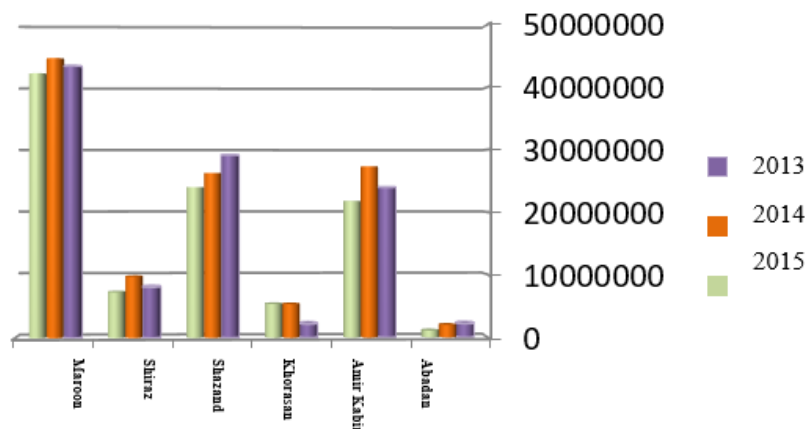| Row | Names of companies / year | 2103 | 2014 | 2015 |
|-----|---------------------------|------|------|------|
| 1 | Abadan | 2227884 | 2019558 | 1132855 |
| 2 | Amir Kabir | 23983233 | 27300777 | 21760746 |
| 3 | Khorasan | 2217109 | 5365083 | 5409882 |
| 4 | Shazand | 29118863 | 26244331 | 23987923 |
| 5 | Shiraz | 8122483 | 9787533 | 7318524 |
| 6 | Maroon | 43267312 | 44476739 | 42074469 |



*Chart 3:* Evaluation of the financial index of sales and services

❖ **Evaluation of the financial index of the final profit**
The table below shows the sales of services and products of six petrochemical companies.

*Table (9):* Estimation of the final profit (Rials)

| Row | Names of companies / year | 2103 | 2014 | 2015 |
|-----|---------------------------|------|------|------|
| 1 | Abadan | 349663 | 302716 | 206950- |
| 2 | Amir Kabir | 2304669 | 3203000 | 2584163 |
| 3 | Khorasan | 3048993 | 2716824 | 2242864 |
| 4 | Shazand | 5935453 | 3717946 | 3008073 |
| 5 | Shiraz | 4257911 | 3596370 | 1375354 |
| 6 | Maroon | 29057763 | 23600557 | 18033159 |

*Table 10:* Prioritization by Fuzzy AHP

| Row | Priority | Points |
|-----|----------|--------|
| 1 | Absolutely important | 7,9,5 |
| 2 | Much more important | 3,5,7 |
| 3 | More important | 5,3,1 |
| 4 | Important | 5,3,1 |
| 5 | Equal | 1, 1,1 |

**Inserting the average of opinions of the experts in fuzzy AHP software for the main indices** ❖

*Table 11*: Opinions of experts for the main índices

| Row | Indicators | Investment | Operational cost | P/E | ROA | ROE | Operational costs for equity |
|---|---|---|---|---|---|---|---|
| I | Investment | | 3.5.7 | 5.7.9 | 5.7.9 | 5.7.9 | 5.7.9 |
| 2 | Operational cost | | | 3.5.7 | 2.4.6 | 2.4.6 | 1.3.5 |
| 3 | P / E | | | | 2, 1.4, 1.6 | 1.2, 1.4, 1.6 | 1,1.2,1.4 |
| 4 | ROA | | | | | 1.1.1 | 1,1.2,1.4 |
| 5 | ROE | | | | | | 1, 1.3, 1.5 |
| 6 | Operational costs for equity | | | | | | |

• We present inserting the average of the opinions of experts in fuzzy AHP software for all investment and operating costs, and P/E, ROA and ROE, and operating costs as an example, comparing 6 petrochemical companies based on investment index, which is collected based on the opinions of experts. Five other comparisons are not mentioned due to prolongation and exactly as the table below.

*Table 12:* Opinions of experts for petrochemical companies

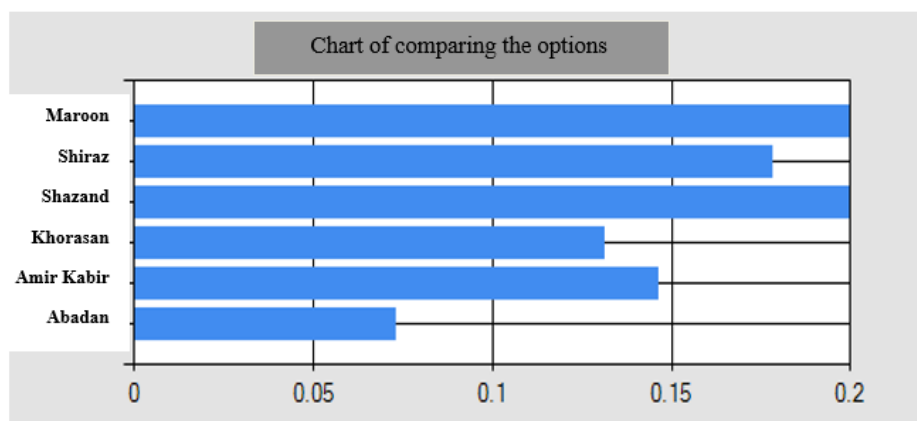| Row | Indices | Abadan | Amir Kabir | Khorasan | Shazand | Shiraz | Maroon |
|---|---|---|---|---|---|---|---|
| I | Abadan | | 3.5.7 | 5.7.9 | 5.7.9 | 5.7.9 | 5.7.9 |
| 2 | Amir Kabir | | | 3.5.7 | 2.4.6 | 2.4.6 | 1.3.5 |
| 3 | Khorasan | | | | 1.2,1.4,1.6 | 1.2,1.4,1.6 | 1,1.2,1.4 |
| 4 | Shazand | | | | | 1.1.1 | 1,1.2,1.4 |
| 5 | Shiraz | | | | | | 1,1.3,1.5 |
| 6 | Maroon | | | | | | |

**Weighted average of petrochemical companies and their ranking (Fuzzy AHP software output)**



*Chart 5:* Weighted average of petrochemical companies and their ranking (Output of Fuzzy AHP software)

*Table 13:* Weighted average of petrochemical companies and their ranking (output of Fuzzy AHP software)

| Row | Company | Weighted average | Ranking of petrochemical companies |
|---|---|---|---|
| 1 | Abadan | 0.07 | 6 |
| 2 | Amir Kabir | 0.14 | 4 |
| 3 | Khorasan | 0.13 | 5 |
| 4 | Shazand | 0.22 | 2 |
| 5 | Shiraz | 0.17 | 3 |
| 6 | Maroon | 0.25 | 1 |

**Explanation:** As is seen, the results of the fuzzy AHP model were ranked almost identically with the results of FP evolution, and the companies with the highest sales and definitive profits obtained the highest ranks in fuzzy calculations.

### Discussion

What was identified as the factors affecting the FP of companies was investment in the petrochemical sector and the cost of operations of petrochemical companies and operating costs for shareholders and ROA and ROE and P/E. However, in evaluation of financial performance, two indices of the rate of sales of services and products and operating profit were also used to help assess the results of FP of these companies clearly and tangibly. Regarding ranking, the first identified factor was the investment factor, and it is clear that as far as no investment is made in any industry, there will be no progress in that industry. Moreover, operating costs of the company and operating costs for shareholders were in the next ranks. This would mean that after investment, it is up to the petrochemical company how to allocate this investment and produce good and high-quality products. In the next ranks are ROA and ROE; ROE and ROA should be used together to evaluate the company's position for investment. These two are different, but together. A clear illustration of the effectiveness of profit generating policies of the company is given to the analysts. If ROA of a company is acceptable and reasonable at the level of debt, the significance of ROE is a good indication of that the management creates a good profit from the money the shareholders have paid for the purchase of the shares. On the other hand, if ROA is small and company debt is large, high ROE may make the investors make mistakes regarding profit of the company. This can be explained by experts because in terms of the ranking these two variables were evaluated the same. For the last rank i.e. P/E ratio, which is P/E= share price in market / (EPS). Theoretically, P/E ratio indicates that the investor tends to pay several units of money in exchange for one unit. From another perspective, this ratio represents investors' (optimism or pessimistic) view towards future growth of the company. This variable being last indicates the base of the positive or negative comments of the individuals on the profitability of petrochemical companies. It should be noted, however, that reliance on the ratio of P/E alone is by no means a suitable measure for doing transactions and this criterion needs to be considered with such items as the growth rate of the industry.

### Results:

According to the ranking, the main indices affecting FP of petrochemical companies were investment in the petrochemical sector, the cost of operations of petrochemical companies, operating costs for shareholders, ROA, ROE, and P/E. The ranking of FP of six petrochemical companies including Abadan, Khorasan, Shiraz, Maroon, Shazand and Amir Kabir was by fuzzy AHP method evaluated according to the six identified indices. This ranking is shown in the following table and in terms of time, it is from 2013 to 2015.

| Row | Company | Weighted average | Ranking of petrochemical companies |
|---|---|---|---|
| 1 | Maroon | 0.25 | 1 |
| 2 | Shazand | 0.22 | 2 |
| 3 | Shiraz | 0.17 | 3 |
| 4 | Amir Kabir | 0.14 | 4 |
| 5 | Khorasan | 0.13 | 5 |
| 6 | Abadan | 0.07 | 6 |

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