

A Comparative Evaluation of the Predictability of Fama-French Three-Factor Model and Chen Model in Explaining the Stock Returns of Tehran Stock Exchange

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Abstract Investors ought to select among different choices and various opportunities which are based on different characteristics and returns. The ultimate goal of most stakeholders, managers and other decision makers of the stock markets are acquiring expected return which is accompanied by risk. This is the reason for the necessity of the balance between risk and return. It is then required to design a model which can satisfactory predict the expected return. The present paper intends to use the two models of three-factor Fama-French and Chen model to contribute the decision makers in investigating the predictability of these two models for selecting the optimum expected return. The sample is composed of 52 listed firms on the Tehran Stock Exchange for the years of 2003 to 2010 which are selected by filtering technique. The gathered data is analyzed by applying multivariate regression method. The findings reveal that the Fama-French model has higher ability in predicting the expected stock return in the capital markets.

Key words Market Risk Premium, Firm Size, M/B Ratio, Investment Value, ROE

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1. Introduction

A new factor model which involves market factor, investment factor and a factor of return on owners' equity is a good beginning to perceive the average expected return of stocks. The companies with higher profitability and lower cost of capital make numerous investments. The investment should have a negative relationship with the expected return to control the profitability. The profitability should also have a positive relationship with the expected return in order to control the investment. The new three-factor model reduces the abnormal returns from a wide range of business strategies which are insignificant. An economic perceive of the performance of the mixed model suggests that it can be used in predicting the expected return in practice.

Regardless of a dominant theory distribution, the empirical performance of Sharp (1964) and Lightner (1965) in capital assets pricing models is incomplete. Fama-French (1993-1996) completed the CAPM model with specific factors and this could explain what CAPM was not capable of. However, it is clear that in the last two decades, Fama-French model has not been able to explain the high penetration on the capital market abnormalities. Examples include the positive association of average returns and extra returns, the negative relationship of average return and financial cease, abnormal instabilities and growth of assets.

We showed that the new three-factor model is a proper beginning point to perceive the abnormalities. The key message is that the compounded impact of investment and ROE is a good opening for understanding

a bigger image of the average expected stock return. Investment factor plays a similar role as the value factor of Fama-French (1993). The companies with higher value ratio confront with higher growth opportunities and more investments. The present paper aims at comparing the predictability of stock return of the firms in Fama-French and Chen model.

2. Theoretical Framework

In this study, I/A and ROE have been classified in forming the new factors. The relativity of the economics means that the investments and ROE effects have conditional nature. The companies with higher profitability or lower cost of capital or both of them make great investments. Additionally, the negative relationship between investment and cost of capital depends on having a given level of profitability. In each case, investment and cost of capital can have positive correlations. If the investor believes in exceptional high profitability, then the positive relationship between profitability and cost of capital depends on having a given investment level. Profitability and cost of capital might have negative correlations. Categorizing I/A and ROE is naturally qualified. Finally, it seems that the impact of cost of capital and investment in small firms is stronger than big firms.

Investment factor also contributes to describing the issuance of net stocks and the growth of unusual assets. Those companies which have higher growth of assets face more investment and lower expected return.

Investment to assets ratio (I/A) is defined as the annual changes in gross property, plant and equipment plus annual variations in inventories divided by the book value of the beginning assets. Changes in property, plant and equipment records the funds invested in the long-term assets like buildings, machinery, furniture and other equipment. Changes in inventories contain investments in the recorded working capital of short-term assets in a normal operational cycle like raw material, the purchased material of supplies, inventories and work-in-process. The economical analyses center measures the gross internal investment in the private sector along with the total fixed investments and net changes in business inventories.

Return on equity adds a new explanatory power to the new model which does not exist in Fama-French model. Profitability shocks have positive association with the asymmetric shocks of returns. Similar to the winners, they have more profitability and achieve more expected return than the losers.

Return on equity is measured as the earnings before the extraordinary items divided by the book value of the owners' equity. Additionally, book value of the owners' equity equals the shareholders' equity plus the deferred taxes and commitment of the investments in balance sheet.

Marshall and Young (2003) examined the relationship between liquidity and stock return. Liquidity measures used in this study is the gap between bid ask price and the flow rate. They used market return and firm size in their model. They concluded that the impact of firm size on the stock return is negative.

Pastour and Stambaugh (2003) tested the risk of liquidity and expected stock return. They studied the stocks of the firms listed on NYSE and AMEX during 1996-1999. They defined liquidity risk as the covariance between stock return and changes in the market liquidity. This is stated consistent with the fact that each share should have different sensitivity to the variations in market liquidity. They found that liquidity risk influences on the assets' pricing.

Chen (2005) investigated the risk premium in pricing the assets. He described the liquidity premium with the macro economic variables with long-term visions. The impact of this factor on assets' pricing has been then considered. Finally, the formed portfolios in the three-factor Fama-French model have been examined by control variables like size and book value to the market value.

Acharya and Pederson (2005) examined the impact of non-liquidity on the assets' pricing models in NYSE and AMEX during the years of 1963-1999. The findings showed that a low liquid stock has an insignificant simultaneous affect on the stock return. In addition, they found that stock returns have significant influences on the future predictable return of the stocks. However, those stocks with lower current returns but higher predictable returns are of more consistent liquidity.

Marcello and Quiros (2006) examined the illiquidity risk of the stock markets in Spain during 1994-2002. They used the size and B/M ratio as the measures of illiquidity offered by Amihud (2002). The findings showed that illiquidity measure is a main component of pricing the assets.

Fama and French (2006) tried to find whether B/M ratio and the proxies of the expected profitability and investment help to explain the average returns. They examined the relationship of the variables by using regression models. They concluded that by controlling the expected profitability and investment, BM ratio would have positive relationship with the expected return.

Michello and Chowdhury (2010) examined the presence of accelerated earnings on the stock market of India during 1991-2006. They found that the momentum earnings are significant for higher market values and portfolios with higher flows for the 6-6 strategy. The evidences showed that the reverse return of 3-3 strategy of winner-loser portfolios is occurred when the companies are sorted by high or low business volume. They also demonstrated that the reverse income is for the 1-1 short-term strategy for both compounds of losers-winners.

Rajgopal and Venkatachalam (2011) tested the relationship between the financial reporting quality and returns volatility in USA during 1996-2001. It was evidenced that the deterioration of earnings quality associates with the returns' volatility in this 40 years period. This positive relationship also holds even after controlling some mediator variables and the impact of some factors like hi-tech newly listed firms, negative earnings firm-year observations and merger and financial pressure.

Verma (2011) analyzed the predictability of the conditional relationship between beta and return in 1970 to 1998. He showed that there is an insignificant positive relationship between current beta (when the market return premium is positive) and future stock returns. In addition, there is an insignificant relationship between current beta (when the market return premium is negative) and the future stock returns. There are similar results observed when the sample is decomposed into January and Non-January months.

Jorgensen et al (2012) examined the earnings dispersion and accumulated stock returns during 1952-2005. They found that there is a positive direct relationship between accumulated stock returns and the dispersion of simultaneous earnings. This is because the dispersion of earnings is more related to higher expected returns. They also documented a negative relationship between accumulated return and the dispersion of future earnings.

Ho et al (2013) tested the conditional pricing of risks during 1980-1998. Their study aimed to examine the impact of conditional pricing of risks in market positions. They employed a five-factor model of pricing assets. These five factors relate to pricing capital stocks including beta, size, B/M ratio, market leverage and stock price. The findings lead to increasing our understanding of capital market behavior and usefulness in internal and international financial decisions of the firms' managers and investors. The following hypothesis is developed for answering to the research questions:

H1: Fama-French model has more ability in predicting the expected stock return than Chen model.

3. Methodology of Research

The present study is an applied study classified as a descriptive-correlation study. This is because it measures the relationship between the variables. The findings of this study are useful for decision making process.

The required data is gathered by library method. The information of literature review and research background has been collected from the expert books and journals. Finally, the information of the financial statements of listed firms has been applied in confirming or rejecting the hypothesis. The databases of Tehran Stock Exchange and the verified software like Rahavarde-Novin have been also used in analyzing the data. The time tertiary of the study covers 2003 to 2010 and the real returns of three years of 2008 to 2010 are predicted by the data during 2003-2007.

The statistical sample is composed of the companies listed on the Tehran Stock Exchange which are selected by filtering technique and the following constraints are executed:

- The end of the fiscal years should be consistent with the calendar year.
- The stocks should be traded for at least 100 days on the Tehran Stock Exchange.
- The company should not be classified as insurance, investment or financial intermediary.
- The required information for computing the research variables should be available.

These limitations finally led to selecting 52 firms as the sample. Excel and SPSS software are also used in analyzing the research findings through multivariate regression models.

4. Data Analysis

Three-Factor Fama-French Model

This model has been introduced in 1993 as follows:

$$r_t - r_{f,t} = \alpha + \beta^M \text{MKT}_t + \beta^S \text{SMB}_t + \beta^H \text{HML}_t + \varepsilon_t \quad (1)$$

Where:

r: stock return

rf: risk-free rate

α : intercept

β^M β^S β^H : the angle coefficients of the market factor, size factor and value factor

MKT: market factor

SMB: size factor

HML: book value to market value (value factor)

T: time

E: residual value

Fama-French (1993) used size and book value to market value (B/M) to form the portfolios. There were 52 sample firms in terms of size which were obtained by the natural logarithm of the capital market value. These companies were sorted ascendingly and 50 percent of the companies smaller than the median were classified as the small firms (S) and 50 percent of the companies larger than the median were classified as big firms (B). Then, each class was segregated into three categories based on the ratio of book value to the market value. According to B/M ratio, 30 percent of the companies had descending classification (except for high companies (H)), 40 percent were mean companies (M) and the remaining 30 companies were classified as low (L) companies. To calculate the formed portfolio of the firms, the weighted average of the portfolio returns was employed. This average is the result of multiplying annual return by the capital market value of the firms. Therefore, six formed portfolios are developed as follows:

$$(S,L), (S,M), (S,H), (B,L), (B,M), (B,H) \quad (2)$$

The first factor (MKT) is the market premium risk which is the same as the beta actor of the model provided by CAPM and is also called market factor. MKT is the difference between market return and risk-free return. Market return is the total ending proxy minus total beginning proxy divided by the total beginning proxy. The risk-free return proxy is the same as the interest rate of the governmental securities.

The second factor (SMB) is the difference between average return of 3 portfolios of small firms and 3 portfolios of big firms which is called size factor.

The third factor (HML) is the difference between the returns of 2 portfolios of the firms with high B/M ratio and 2 portfolios of the firms with low B/M ratio. This is also called value factor.

Three-factor Model of Chen et. al. This model has been introduced in 2011 as follows:

$$r_t - r_{f,t} = \alpha + \beta_{\text{MKT}}^i \text{MKT}_t + \beta_{\text{INV}}^i \text{INV}_t + \beta_{\text{ROE}}^i \text{ROE}_t + \varepsilon_t \quad (3)$$

$$r_t - r_{f,t} = \alpha + \beta^M \text{MKT}_t + \beta^S \text{SMB}_t + \beta^H \text{HML}_t + \varepsilon_t$$

r: stock return

rf: risk-free rate of Return

α : intercept

β_{MKT}^i , β_{INV}^i , β_{ROE}^i : the angle coefficients of the market factor, investment factor and ROE factor

MKT: market factor

ROE: return on Equity Factor

INV: investment factor

T: time

E: residual value

The sample firms are classified into three categories based on the investments which are achieved by dividing the investments by the total book value of the assets. For the investment factor, 30 percent of the companies have intensified investments value (I), 40 percent have average investment values (N) and the remaining 30 percent of the companies have low values of investments (V). Any of these categories are then subdivided into three other classes based on the return on equity. For ROE, 30 percent of the companies are classified as the companies with high level (R), 40 percent as with the mean level (O) and the remaining 30 percent as the low level (E). In this study, investment is defined as the annual changes in property, plant and equipment plus the annual changes in merchandises and materials. Additionally, the formed portfolio is computed by the average mean of the portfolio which is obtained by multiplying annual return by the capital market value. The 9 formed portfolios are then created as follows:

$$(I,R), (I,O), (I,E), (N,R), (N,O), (N,E), (V,R), (V,O), (V,E) \tag{4}$$

The first factor (MKT) or market premium risk is the Fama-French model described in the previous section.

The second factor (INV) is the difference between the simple mean of the return of 3 portfolios with low investment value and the simple mean of the return of 3 portfolios with high investment value.

The third factor (ROE) is the difference between the simple mean of the return of 3 portfolios with high equity and the simple mean of the return of 3 portfolios with low equities.

In this study, the return of the next three years has been predicted by using the data related to five years.

Table1. The data related to the years of 2003 to 2007

Year	MKT	SMB	HML	Mean of E(R _i)	r _f	E(R _i) - r _f
2003	1.073936	-167.58	-74.3162	108.2937	0.17	108.1237
2004	-0.11173	25.75229	-27.7601	60.22154	0.17	60.05154
2005	-0.37512	0.05314	-1.11086	23.60038	0.17	23.43038
2006	-0.11717	-12.538	-73.2077	51.45981	0.17	51.28981
2007	-0.12957	-9.85889	-25.2262	31.12827	0.17	30.95827

Using the linear regression model and examining the impact of MKT, SMB and HML on the real returns during 2003 to 2007, the coefficients of the regression model has been computed. The regression model is as follows:

$$E(R_i) - r_f = 53.7 + 95.3 \text{ MKT} + 0.364 \text{ SMB} - 0.162 \text{ HML} \tag{5}$$

The estimated coefficients of five years predicted the real return for the years of 2008 to 2010.

Table 2. The predicted returns for the years from 2008 to 2010

Year	MKT ₃	SMB ₃	HML ₃
2008	-0.39019	-1.29319	-28.2903
2009	0.413814	-17.9365	-43.8828
2010	0.676758	-76.0177	-12.8507

Table 3. Comparison of real and predicted return for the years from 2008 to 2010

Year	R _i (3sal)	R _i (real)
2008	20.80232	40.16327
2009	93.87837	67.00135
2010	92.76867	61.05327

The Model of Chen et. al. Using the five-year data, the return of the next three years has been predicted.

Table 4. The data related to the years from 2003 to 2007

Year	MKT	INV	ROE	Mean of E(R _i)	r _f	E(R _i)- r _f
2003	1.073936	-91.4656	72.4124	108.2937	0.17	108.1237
2004	-0.11173	-8.89126	30.15653	60.22154	0.17	60.05154
2005	-0.37512	12.81495	-15.8434	23.60038	0.17	23.43038
2006	-0.11717	62.71994	46.31937	51.45981	0.17	51.28981
2007	-0.12957	24.81266	8.698169	31.12827	0.17	30.95827

Using the linear regression model and examining the impacts of MKT, INV and ROE on the real return during 2003 to 2007, the coefficients of the regression model has been computed. The regression model is as follows:

$$E(R_i) - r_f = 33.7 - 10.6 \text{ MKT} - 0.325 \text{ INV} + 0.768 \text{ ROE} \quad (6)$$

The estimated coefficients of five years predicted the real return for the years of 2008 to 2010.

Table 5. The predicted return of the years from 2008 to 2010

Year	MKT	INV	ROE
2008	-0.39019	2.796916	18.83172
2009	0.413814	-42.0364	24.12866
2010	0.676758	-6.55103	95.4333

Table 6. Comparison of real and predicted return for the years from 2008 to 2010

Year	R _i (3sal)	R _i (real)
2008	51.58311	40.16327
2009	61.70253	67.00135
2010	102.1444	61.05327

Table 7. Comparison of predictability in both models

	Correlation coefficient between real and estimated return
Chen et al	0.481
Fama-French	0.980

According to table 7, the correlation between real and estimated data during 2008 to 2010 is higher for Fama-French model rather than Chen's model. In other words, Fama-French model has more predictability in describing the expected stock return. For this reason, the real and estimated returns in the Fama-French model are close to each other.

5. Conclusion and Discussion

The main task of the securities' analysts is usually estimating the future performance of the stocks in relation to risk and return and the correlation coefficient between total shares which are going to be placed in the portfolio compound. The existing approaches are single factor and multi factors models. The later model predicts the risk with the accumulative violations resulting from a cross-sectional factor. The new three-factor model includes market factor, investment factor and ROE factor which are good beginnings for perceiving the abnormal capital stocks. The prior studies conducted for selecting a pricing method documented that a negative price is resulted from the risk for the violations of systematic risk. Simultaneously, the findings

revealed that those stocks which lead to innovation in the volatilities of total market had lower future returns. In the present paper, the comparison between the two models of Chen et al. and Fama-French, demonstrated that size and value factors in Fama-French model have more predictive ability than the two factors of investment and ROE in Chen's model. However, the market factor in both models is similar. It can be also found that value factor (calculated by B/M ratio) in Fama-French model has more ability in predicting the future stock returns than the other model (calculated by dividing investments by the total book values of assets). In sum, it can be concluded that Fama-French model has more ability in describing the expected stock return.

Based on the studies in this field and the requirements of the capital market, the following characteristics are suggested:

- In this study, the impact of inflation on the Iran's capital market and other macro economic variables which might affect the information stated on the financial reports has not been considered. Therefore, it is suggested to take the effect of macroeconomic variables into account for the further studies.

- Based on the various factors affecting the capital market, risk and return of the securities, it is suggested to consider the influences of control variables such as size, B/M ratio, cash flow, etc.

- The investors, directors and other stakeholders are also offered to use three-factor Fama-French model to obtain the optimum expected return.

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