Prediction of Expected Rate of Return in Tehran Stock Exchange

Zahra Amirhosseini, Somayeh Mohseni Behbahani

***Abstract*—in this paper we examine Arbitrage Pricing theory and Adjusted Capital Assets pricing model in Tehran stock exchange to find best model for predicting of share's expected rate of return. The question in Securities of Iran is which one of pricing models has better and more precise result for pricing stocks of company. The most important factor on investment decisions are rate of investment return, assigning price of investment, predication future from mind of investigator and return of assets predicate by risk. Among recognized patterns for assigning return are Adjusted capital assets pricing model (Adj-CAPM) and Arbitrage pricing theory (APT). In this research the expected rate of return will be explaining in Adj-CAPM on the basis of liquidity risk and in APT on the basis of set of risk «price of oil, price of gold, inflation, and rate of foreign exchange, rate of interest and index of stock exchange». The main purpose of this research is the examination of ability explaining Arbitrage pricing theory and Adjusted capital assets pricing model for predicting expected rate of return. For this purpose, first, the Betas have been computed, and then according to betas, expected return of two models will be computed. Therefore by using Regression Analyzing and Pearson Correlation we will reach to this result that Arbitrage Pricing Theory has more performance and ability than Adj-CAPM Pricing Model.**

***Key Words:* Expected Rate of Return, Arbitrage Pricing Theory, Adjusted Capital Assets Pricing Model, Prediction.**

I. Introduction

Risk, return and investment are one of the most important concepts in modern financial theory. Different types of assets are evaluated based on risk and return. Several factors are observed while buying stocks. One of the most important of these factors is ability to change them into cash which is called Liquidity i.e. investors intend that simply and in minimum time to change their share into cash in case of necessity. Therefore one of the most effective factors on expected rate of return is liquidity power in which in adjusted capital asset pricing model this issue is studied based on liquidity risk. This model offers a pattern to us in which we will be able to studying effectiveness of liquidity risk on price of assets. In the present research we attempt to offer asset pricing model in accordance with liquidity risk and compare its expected rate of return with expected rate of return for arbitrage pricing model in which more than one factor is observed.

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Among recognized patterns for specifying process of creating return we may refer to capital asset pricing model (CAPM) (single factor) in which expected rate of return for each share is measured by beta (systematic risk) or Adjusted capital asset pricing model (ADJ-CAPM) in which expected rate of return of each share with liquidity risk of that share is measured by adjusted beta. Another choice that is introduced is Arbitrage pricing theory (APT) which is regarded as famous financial science theories which was suggested by Stephen Ross (1976). He brought up this theory in response to criticisms against capital asset pricing model. He claimed that return of different securities is influenced by several factors at macroeconomic and capital market. Chen, Roll, and Ross (CRR, 1986) identify four macroeconomic factors as the ''fundamental'' forces: changes in industrial production; changes in expected and unexpected inflation; changes in risk premium; changes in term structure. They demonstrate that the macroeconomic factors significantly explain the cross-section of stock returns. Flannery and Protopapadakis (2002) find that stock returns are correlated with inflation and money growth. The variables formulated into a linear model as suggested by CRR (1986) as follow:

$$R_i = b_{i0} + b_{i1}F_1 + b_{i2}F_2 + ... + b_{ik}F_k + e_i$$

Where R_i, actual return on the portfolio i; b_i, is the reaction coefficient measuring the change in portfolio return for change in risk factors, F_i is the macroeconomic factor and e_i, a residual error for portfolio. In this study, the factors tested are: F_1, the inflation; F_2, price of gold; F_3, the foreign exchange rate; F_4, price of crude oil in Iran; F_5,index of stock exchange; F_6, bank interest rate. So we used a liner model as follow:

$$R_i = b_{i0} + b_{i1}F_1 + b_{i2}F_2 + b_{i3}F_3 + b_{i4}F_4 + b_{i5}F_5 + b_{i6}F_6 + e_i$$

In the capital asset pricing model (CAPM), factors are priced only if they present a form of systematic or non-diversifiable risk. Initially, a stock's co-movement with the market (market beta) was seen as the only form of systematic risk. However, the failure of market beta to explain the cross-sectional expected returns cast doubt on it being the sole important determinant of stock returns (Fama and French, 1992, 1993). As a result, a host of other factors such as firm size and book-to-market (BM) ratio have been confirmed in addition to beta in explaining how stock returns are generated. In contemporary literatures, stock

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liquidity, which is defined as the ease and speed at which one can trade stocks in the market, is another factor that has been investigated for the purpose. Amihud and Mendelson (1986), Brennan and coworkers (2004, 1998), Chordia coworkers (2000) and Fiori (2000) have established a negative relationship between stock's return and the level of its liquidity. This is often interpreted as reflection of liquidity risk premium. Moreover, Chordia et al. (2000) pointed out that well-known financial events such as the international stock market crash of October 1987 and the liquidity crisis in the bond market in 1998 were not linked to any specific major news, but were characterized by a temporary reduction in aggregate market liquidity. Such liquidity shocks are potential channels through which financial asset prices are influenced by liquidity. It shows that liquidity has a systematic component even after accounting for individual stock's liquidity determinants such as trading volume and its volatility. Most recently, market wide commonalities also found in Thailand (Pukthuanthong-Le and Visaltanachoti, 2009). Huberman and Halka (2001) argue that if the systematic component of liquidity cannot be diversified away, a stock should earn a certain amount of compensation return, depending on stock's exposure to the systematic component of liquidity. Pastor and Stambaugh (2003) and Amihud (2002) formally test this proposition. They found that expected stock returns and the level of market liquidity have a negative relationship.

$$ILLIQ_t^i = \frac{1}{\mathrm{DAYS}_t^i} \sum_{d=1}^{\mathrm{DAYS}_t^i} \frac{|\mathrm{R}_{td}^i|}{\mathrm{V}_{td}^i}$$

Where R_{td}^i and V_{td}^i are, respectively, the return and dollar volume (in millions) on day d in month t, and $DAYS_t^i$ is the number of valid observation days in month t for stock i.

Adj-CAPM cause, risk-averse agents in an overlapping generation's economy trade securities whose liquidity varies randomly over time. Solve the model explicitly and derive a liquidity-adjusted capital asset pricing model (CAPM). This model of liquidity risk complements the existing theoretical literature on asset pricing with constant trading frictions.

In the liquidity-adjusted CAPM, the expected return of a security is increasing in its expected illiquidity and its ''net beta,'' which is proportional to the covariance of its return, r_i; net of its exogenous illiquidity costs, c_i; with the market portfolio's net return, r_M _ c_M: The net beta can be decomposed into the standard market beta and three betas representing different forms of liquidity risk. These liquidity risks are associated with: (i) commonality in liquidity with the market liquidity, cov(c_i; c_M); (ii) return sensitivity to market liquidity, cov(r_i ; c_M); and, (iii) liquidity sensitivity to market returns, cov(c_i; r_M). In the unique linear equilibrium, the conditional expected net return of security i is:

$$E(r_{t+1}^i - C_{t+1}^i) = r^f + \lambda_t \frac{\mathrm{cov}_t(r_{t+1}^i - C_{t+1}^i, r_{t+1}^m - C_{t+1}^m)}{\mathrm{var}_t(r_{t+1}^m - C_{t+1}^m)}$$

Where $\lambda = E_t(r_{t+1}^m - C_{t+1}^m - r^f)$ is the risk premium?

There are two problems with using ILLIQ: First, it is measured in ''percent per dollar,'' whereas the model is specified in terms of ''dollar cost per dollar invested.'' This is a problem because it means that ILLIQ is not stationary (e.g., inflation is ignored). Second, while ILLIQ is an instrument for the cost of selling, it does not directly measure the cost of a trade. To solve these problems, we define a normalized measure of illiquidity, c_t^i; by

$$C_t^i = min\,(0.25 + 0.30 ILLIQ_t^i R_{t-t}^M, 30.00)$$

The R_{t-t}^M adjustment solves the first problem mentioned above, and it makes this measure of illiquidity relatively stationary. The coefficients 0.25 and 0.30 are chosen such that the cross sectional distribution of normalized illiquidity (c_t^i) for size-docile portfolios has approximately the same level and variance as does the effective half spread (Acharya &Pendersen, 2005).

In the present research we attempt to study whether arbitrage pricing theory may offer better and more exact performance to predict expected rate of return and pricing of accepted share in Tehran stock exchange (which is regarded as principal market of creating capital in Iran) in comparison to adjusted capital asset pricing model.

II. Research Model

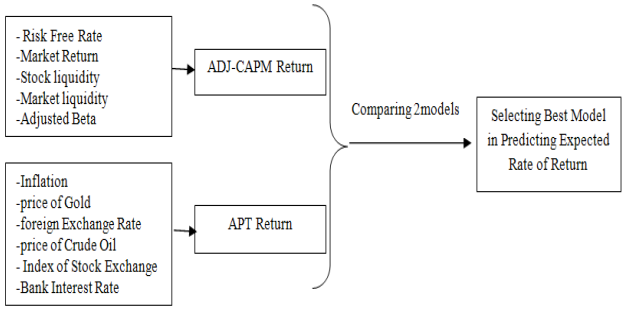

Fig1: Predicting Expected Rate of Return

III. Methodology

The main objective of the present research is to comparing APT and Adj-CAPM for approximating best model in predicting expected rate of return. Research method is according to survey method and data are analyzed by Pearson correlation coefficient, regression analysis and Fisher test. Statistical population of the present research includes 60 companies active at Tehran stock exchange within time period 2002-2009. We have used from data of Tehran stock exchange organization, central bank, Iran petroleum company during 8 years.

IV. Hypothesis Testing

In the present research only one hypothesis has been observed. This hypothesis in order to compare prediction of expected rate of return applies from two models is "Ability of explaining expected rate of return in Arbitrage pricing model is higher than Adjusted capital assets pricing models".

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***1**-Pearson Correlation Coefficient Test*:

Correlation between calculated return from two models and real return is indicated in table 1.

Table 1: Correlation between calculated return from Adj-CAPM, APT model and real return

		Real Return	APT Return	Adj-CAPM Return
Real Return	Pearson Correlation Sig. (2-tailed) N	1 60	.974 .000 60	.886 .000 60
APT Return	Pearson Correlation Sig. (2-tailed) N	.974 .000 60	1 60	.906 .000 60
Adj-CAPM Return	Pearson Correlation Sig. (2-tailed) N	.886 .000 60	.906 .000 60	1 60

As it is indicated there is correlation between calculated return for adjusted capital asset pricing model and real return. Also there is correlation between calculated return for arbitrage capital asset pricing model and real return. But by using table 1 we may not mention that which of these two models have higher ability in explaining return. Based on collected data from sample group and after calculating correlation coefficient, the correlation variables in two models are changed to *Zr* variable which has nearly normal distribution and null and opposite hypothesis are tested whereas follows:

$$\begin{cases} H0: \rho_1 = \rho_2 \\ H1: \rho_1 \prec \rho_2 \end{cases}$$

H0: Ability of explaining expected rate of return in Adj-CAPM and APT is equal.
H1: Ability of explaining expected rate of return in APT is higher than Adj-CAPM.

$$\mathrm{Zob} = (\mathrm{Z_{r1}} - \mathrm{Z_{r2}}) / \sqrt{\frac{1}{\mathrm{n_1} - 3} + \frac{1}{\mathrm{n_2} - 3}}$$

$$zob = \frac{2.165 - 1.403}{\sqrt{\frac{1}{57} + \frac{1}{57}}} = \frac{-0.3816}{0.187317} = 4.06$$

Calculated statistics of Zob equals to 4.06 in which this amount is not among confidence interval 0.95; in other words whereas Zob is in critical region the null hypothesis may not be accepted. The result is that based on evidences the ability of explaining expected rate of return in model APT is higher than Adj-CAPM model.

***2**-Regression Analysis:*

For regression analysis for each approach each of the following regression patterns may be executed:

$$\mathrm{E(R_j^A)} = \mathrm{R_f} + \mathrm{E(C_j)} + (\mathrm{E(R_m)} - \mathrm{E(C_m)} - \mathrm{R_f})\,\beta_j^A$$

$$E(R_J) = R_f + \beta_{j1}[E(R_1) - R_f] + \ldots\ldots\ldots + \mathrm{b_{jk}}[E(R_j) - R_f]$$

Therefore in any approach instead of Rj the suitable return for each pattern will be written i.e. for test of hypothesis we will execute two aforesaid regression patters so that Rj will be equal to expected rate of return achieved from any model and constant sentence Rf is interpretation of risk free rate. Existence of E(Cj) in initial regression model indicates cost of illiquidity.

***2-1** Regression Analysis for Adj-CAPM Model:*

Upon considering regression pattern and expected rate of return for Adj-CAPM model as dependent variable the results of correlation coefficient and meaningful test of executing regression is whereas table (2).

Table 2: Results of regression test mode Adj-CAPM

Independent Variable	Sig	R2	R
Cost of illiquidity	0.000	0.227	0.476

As it is indicated from table 2 the correlation coefficient equals to 0.476 which indicates relationship of dependent and independent variable and R2 equals to 0.227 which indicates that this model only as 0.227 is able to describe dependant variable i.e. liquidity risk is only able to describe 0.227 return and the remained 0.773 are unknown factors which influence on return of share in Tehran stock exchange. Level of meaningfulness equals to zero and is lower than 0.05. It is concluded that at level of 0.95 certainty there is meaningful relationship between illiquidity and return.

***2-2** Regression Analysis for APT Model:*

By observing regression pattern and return of APT model as dependent variable the results of correlation coefficient and meaningful test to execute regression is whereas table (3).

Table 3: Results of regression test for APT model

Independent Variable	Inflation Beta	Beta of Bank Interest Rate	Beta of Price of Gold	Beta of Price of Crude Oil	Beta of Index Stock Exchange	Beta of Foreign Exchange Rate
Sig	0.912	0.424	0.458	0.020	0.000	0.010
R^2	0.532					
R	0.730					

As it is indicated from table 3, correlation between independent variables and return equals to 0.730 and determination coefficient equals to 0.532. Also only beta of crude oil in Iran, beta of foreign exchange rate and beta of index of stock exchange at confidence level 0.95 has meaningful relationship with dependant variable i.e. return of APT model and there is no meaningful relationship between variable beta of gold, beta of banking interest and inflation with return of arbitrage model at any level.

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Therefore these three independent variables shall be eliminated from model and the regression test for other

Table 4: Results of regression test for APT model

	R2	R
APT	0.515	0.717

As it is indicated from table 4, correlation between independent variables (price of crude oil in Iran, foreign exchange rate and index of stock exchange) and return equals to 0.717. R2 for arbitrage model equals to 0.515. On the other hand amounts of R and R2 do not have great difference with amounts of previous model, therefore it is concluded that independent variables which have meaningful relationship with return in arbitrage pricing model, have very small influence on return.

Whereas correlation coefficient only indicates relationship between variables, in order to test hypothesis we shall use from Fisher test; since according to collected data from sample group and after calculating correlation coefficient, the correlation variables at both populations is changed to Zr variable with normal distribution. Therefore null and opposite variables are tested whereas follows:

$$\begin{cases} H0: \rho_1 = \rho_2 \\ H1: \rho_1 \prec \rho_2 \end{cases}$$

H0: Ability of explaining expected rate of return in Adj-CAPM and APT is equal.

H1: Ability of explaining expected rate of return in model APT is higher than Adj-CAPM.

$$\text{Zob} = (Z_{r1} - Z_{r2}) / \sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}$$

$$zob = \frac{0.5178 - 0.8994}{\sqrt{\frac{1}{57} + \frac{1}{57}}} = \frac{-0.3816}{0.187317} = -2.037$$

APT: R= 0.717, N=60

Adj-CAPM: R=0.476, N=60

Zob statistics equals to -2.037 in which this amount is not among confidence interval of 0.95, i.e. whereas calculated statistics Zob is in critical region, the null hypothesis may not be accepted. It is concluded that based on evidences the ability of explaining expected rate of return in model APT is higher than Adj-CAPM model.

V. Conclusion

The aforesaid hypothesis was studied by Pearson correlation coefficient and regression analysis. Correlation coefficient(cost of illiquidity and return) calculated at Adj-CAPM compared with correlation coefficient(factor creating risk including price of crude oil, rate of foreign currency, index of stock exchange and return) calculated at APT; whereas coefficient of correlation and coefficient of determination only indicates existence of relationship and does not indicate intensity of relationship. To compare APT and Adj-CAPM coefficient of correlation, we have used Fisher test. The result indicated that ability of explaining expected rate of return in APT model is higher than Adj-CAPM. Therefore calculated return by using arbitrage pricing model has higher ability for predicting the expected rate of return in comparison to calculated return at Adjusted capital asset pricing model. It is suggested to investors, to use arbitrage pricing model for predicting the expected rate of return and for investment on stock exchange, it is better to identify other factors which may be effective on share return and test arbitrage pricing model so that coefficient of determination will be very close to one.

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