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# Defining and Designing a Model to Predict the Performance of Mutual Funds by Using Macroeconomic Variables in Tehran Stock Exchange

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**Abstract**

Given the importance of the mutual funds in capital market and the role of these funds in the capital market development, the expected return of funds is very important. In this study, the macroeconomic variables were investigated to predict the performance of mutual funds in Tehran Stock Exchange. In this study the performance of 67 mutual funds in Tehran Stock Exchange for the December 2008 to 29 March 2013 were reviewed. Macroeconomic variables consisted of oil prices, inflation, liquidity, exchange rate, the price of gold and the housing price indices. Data analysis was done by multiple linear regression models and artificial neural network (ANN). Results indicated a significant relationship among the rate of inflation, liquidity, exchange rate and housing price indices and return of funds. A model was offered to predict the performance of mutual funds.

**Keywords:** mutual funds, unit, macroeconomic variables and mutual funds return.

## Introduction

Financial research on factors affecting the performance of assets or shares of a portfolio consisting of any combination of shares (or other assets) is of particular importance. One of the most important types of financial assets is mutual fund. The focus of this study was to investigate factors affecting the performance of mutual funds since the beginning of these funds in the Tehran Stock Exchange. These boxes are popular because they are safe. Mutual funds in Tehran Stock Exchange of Islamic Republic of Iran were enacted by the Securities of Market Law in 2005 and since 2008 have started to work and the "development of new financial instruments and institutions in order to facilitate the implementation of the general policies of principle of fourth constitution " was adopted in 2009 which had facilitated their performance. The "development of new financial instruments and institutions to facilitate the implementation of the general policies of principle of constitution" had led to the publication of the units in the subject of the approved investment. The law is defined as unit: Unit (certificate investment); uniform securities issued by mutual funds and investment compensation fund and investor profile figures in the box with insert and the amount of funding provided to them (the development of new financial instruments and institutions in order to facilitate the implementation of the general policies of principle of constitution, 2009). Now the initial value of each unit at the time of establishment of each mutual fund in Iranian rial is 1,000,000 million.

## Theoretical Framework

Asset pricing models were used in explaining the factors affecting the efficiency. Perhaps the most famous of these models is formulas mean- variance which was developed by Sharpe (1964), and created by Lintner (1965), Black (1972), Long (1974), Rubinstein (1976), Breeden (1979) and Cox et al (1985). These models are based on the Capital asset pricing model. It is the most capital-asset pricing model (CAPM). Multifactorial models were used by researchers for better explanation of ROA. One of the most popular models is multifactorial, arbitrage pricing theory (Ross, 1976). Arbitrage pricing theory refers to the expected rate of return on portfolio capacity which describes

the factors affecting efficiency. One advantage of this theory is that it does not require the strong assumptions used in the pricing of capital assets theory (Elton et al., 2003).

The most common variables used in the literature include market Index, the interest rate, currency, the price of oil, and the price of gold

Some studies show that financial data modeling by using artificial neural network (ANN) functions more efficiently than traditional linear models and regression. Hill et al and Makridakis et al critically have examined the performance of artificial neural networks (ANN) and have claimed that the artificial neural networks (ANN) are dominant on many limitations of statistical models, such as errors in diagnosis, bias, failure and non-linear modeling of discrete data (Makridakis et al, 1982; Hill et al, 1996). Pesaran and Timmermann identified 9 predictive variables for the period 1952- 1992 in the 512 linear regression and multiple component predictors. However, the predictive model changes over time and tends to change with the market volatility (Pesaran & Timmermann, 1995). With the implementation of the portfolio strategy, Qi linear recursive utility model is compared with artificial neural networks (ANN). Artificial neural network (ANN) model of linear regression model was doubled (Qi, 1999). The performance and stability of the financial forecasts and the use of artificial neural networks (ANN) have increased dramatically from 1988 onwards (Fadlalla and Lin, 2001; Trippi & Turban, 1992). Artificial Neural Networks (ANN) have been successfully used to analyze credit, bankruptcy risk prediction, and to predict the performance of mutual funds and all applications including a range of non-linear data structures. Similarly, growing numbers of investigations of nonlinear predictability of stock returns is with data discovery (Abhyankar et al, 1997).

**Background of study**

Empirically, arbitrage pricing theory has been studied in several markets. For example, this theory was studied by Antoniou (1998) on the London Stock Exchange, Dhankar and Singh (2005) in the Indian stock market, Chen et al (1986) on the New York Stock Exchange, Azeez and Yonezawa (2006) in the Japanese stock market and Anatolyev (2008) in Russian stock market. Goyal and Welch (2004) conducted a comprehensive study to predict the performance of a portfolio of stocks with a breakdown of the 16 predictor variables. Their data (from 1927 to 2003) was divided into the collection of the sample and out-of-sample predictions. There is no significant relationship between the set of predictor variables, either alone or in combination with no returns. Fama and Gibbons (1982) have examined the relationship between inflation and the real return on invested capital. The results confirmed the findings of Mundell (1963) that the expected real return on short-term bonds and expected rates of inflation are negatively correlated with each other. Geske and Roll (1983) found that America's stock price has a negative correlation with inflation while the economy has a positive correlation with the real ones. In testing the reliability and validity of the arbitrage pricing theory, Chen, Roll and Ross (1986) concluded that the macroeconomic variables are randomly associated with stock returns. Najand and Rahman (1991) randomized evidence of the relationship between stock returns and inflation reached by using the Schwert volatility scale.

Also, many studies have been done on the use of neural networks in finance. The primary areas of research that has used this algorithm can be used to predict the performance of mutual funds in the financial markets to identify and predict the variables affecting the operation. Lemke and Muller (1997) used a two-stage neural network based on GMDH algorithm so that the expected return on the mutual fund paid and then in the next step a mechanism was designed to "process control" which expected to convert the buying and selling signals. Also, Sutheebanjard and Premchaiswad (2010), Mehrara, Moeini, Ahrari and Ghafari et al (2010), Tong Seng (2007) and Koayang (2005) have predicted stock market prices by using the ANN models, BPNN, GMDH,

MBNN and ANFIS. All studies' results indicated that the neural network model of forecasting accuracy is high. Saeedi and Moghaddasian (2010) conducted a study on the performance of mutual funds in Tehran Stock Exchange and found a relationship between market efficiency and return on mutual funds. Saeedi et al (2010) examined the ten factors affecting the efficiency of mutual funds (including the performance of the fund's portfolio in the industry, the growth rate of the fund, the value of export, the value of cash held by the Fund, the percentage of ownership, value of redemption, market efficiency, the mean absolute deviation as a risk indicator, the ratio of capital and the return of previous period). Compilation and analysis of data were performed with the fixed effect OLS regression (OLS). Results indicated a significant linear relationship between the 6 variables (in order of preference) market efficiency, the growth rate of the fund value, mean absolute deviation of fund returns, export unit value, ratio of the value of the fund approved the redemption unit with efficiency. Pourzamani and et al (2010) demonstrated a significant and positive correlation among returns earned by the fund and volatility of fund returns to the previous period, the returns of the fund, age fund assets under management and fund flow rate to the previous period.

**Mutual funds in Iran**

Entrepreneurial mutual fund (which invests in fixed-income securities) was the first mutual funds in Iran which was launched on 14 July 2007. Currently, the mutual funds, investment value on each unit is equal to one million (equivalent to approximately US $ 31.5 America). Depending on the type of fund, the minimum and maximum number of units of mutual funds is common. One hundred percent of the initial subscription shall be underwritten on the basis of investment units. The funds will continue to provide detailed information on 20 March 2014.

**Table 1. Funds and some details have been provided in the attached report, 20 March 2014**

| Total Funds | The number of mutual funds | The value of mutual funds (billions of dollars) | Number of units | The number of investors in mutual funds | | |
|---|---|---|---|---|---|---|
| | | | | Personal investors of 2013 | Institutional investors of 2013 | Collection of 2013 |
| Total | 119 | 39,788 | 225010185 | 108817 | 1114 | 109921 |

**Table 2. Trading volume and the issuance and redemption of mutual funds, 20 March 2014**

| Total Funds | The value of stock transactions (millions of rials) | | | The issuance and redemption (millions of rials) | | |
|---|---|---|---|---|---|---|
| | Buy | Sale | The differentials increase (decrease) | Issuance | Redemption | The differentials increase (decrease) |
| Total | 30,094,727 | 24,565,880 | 5,528,847 | 40,559,857 | 27,632,586 | 12,927,271 |

**Hypotheses**

The hypothesis of this study is as follows:

H1: There is a significant relationship between the return on mutual funds and changes in macroeconomic variables.

H2: Predicted error rate of return in mutual funds by using an artificial neural network (ANN) approach is lower than predicted by the regression model.

**Data, variables and methods**

In this research, mutual funds that on 15 July 2009 to 15 July 2013 have been active were studied. In the present study, a regression model was used to examine the impact of macroeconomic variables on the yield of mutual funds pay and return funds studied the predictions of our model.

This model is shown in the following:

$$RNAV_{it} = \alpha_i + b_{i1}INF_{it} + b_{i2}MS_{it} + b_{i3}EX_{it} + b_{i4}OIL_{it} + b_{i5}GD_{it} + b_{i6}HS_{it} + u_{it}$$

**Table 3. Symbol variables used in the study and the model**

| Variable name | Description | Symbol variable in the model |
|---|---|---|
| $OIL_t$ | Oil prices (average price of light and heavy crude oil) at time t | x1? |
| $GD_t$ | Gold prices (prices in $ per ounce) at time t | x2? |
| $EX_t$ | Currency (USD on the open market) at time t | x3? |
| $INF_t$ | Inflation rate (consumer goods and services price index) at time t | x4? |
| $MS_t$ | Liquidity (money supply variable or liquidity: M1 plus deposits are defined as non-visual) at time t | x5? |
| $HS_t$ | Housing price index at time t | x6? |
| R NAV $^t$ | Return of net asset value redemption (after deducting fees) in time t :(net asset value redemption at time t minus net asset value redemption of the 1-t divided by the net asset value redemption at the time 1-t) $\left(\frac{NAV_t - NAV_{t-1}}{NAV_{t-1}}\right)$ | y1? |
| $b_{in}$ | Sensitivity coefficient of each factor to the performance of net mutual funds | B |

Then, the effect of macroeconomic variables mentioned in the previous section and return on mutual funds was examined by using the neural network.

The general model of artificial neural network (ANN) will be as follows:

$$R_{jt} = \sum_{i=1}^{7} \pi_i x_{it} + \sum_{j=1}^{q+1} \theta_j a_{jt}$$

**Results**

This section presents the findings of research on the assumptions discussed. The overall model was used to analyze the panel. The reason for using this method is due to the nature of the data. For the analysis of panel data gathered a cross. In this case, the data that are collected independence of observations cannot be maintained because of several months of each fund's view that these observations are interdependent. In other words, the analysis of the data is multiplied by the number of years and the number of companies. Using multiple models to estimate the model parameters used in the model is done by controlling other variables. Although the coefficient of determination is important in practice, the members in bourse market data to determine the expected value is not high. In the third stage, the significance of the model parameters is estimated by using the table of the coefficients and t-statistics. As mentioned in the section on the perception of P-value or significant level, whenever the probability or significance level of the test to be less than 0.05 first hypothesis is rejected at the 95% level of reliability.

***The first model run***

Y1 = C(1)*X11 + C(2)*X21 + C(3)*X31 + C(4)*X41 + C(5)*X51 + C(6)*X61 + C(7)

Dependent Variable: Y1?

Method: Pooled EGLS (Cross-section random effects)

Date: 06/26/14 Time: 12:41

Sample (adjusted): 2008Q1 1391Q4
Included observations: 20 after adjustments
Cross-sections included: 67
Total pool (unbalanced) observations: 733
Swamy and Arora estimator of component variances
White diagonal standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

**Table 4. The final model in the form of random effects**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -2020182. | 245936.9 | -8.214227 | 0.0000 |
| X1? | 2388.359 | 1379.067 | 1.731866 | 0.0837 |
| X2? | 513.6062 | 235.5304 | 2.180636 | 0.0295 |
| X3? | -52.82674 | 19.70540 | -2.680825 | 0.0075 |
| X4? | 986265.5 | 461094.0 | 2.201068 | 0.0328 |
| X5? | 0.279233 | 0.053443 | 5.224849 | 0.0000 |
| X6? | -353.2248 | 179.7381 | -1.965219 | 0.0498 |
| | Effects Specification | | | |
| | | | S.D. | Rho |
| Cross-section random | | | 506471.5 | 0.5431 |
| Idiosyncratic random | | | 464505.9 | 0.4569 |
| | Weighted Statistics | | | |
| R-squared | 0.513208 | Mean dependent var | | 398717.4 |
| Adjusted R-squared | 0.509185 | S.D. dependent var | | 703711.6 |
| S.E. of regression | 498285.9 | Sum squared resid | | 1.80E+14 |
| F-statistic | 127.5661 | Durbin-Watson stat | | 2.017017 |
| Prob(F-statistic) | 0.000000 | | | |
| | Unweighted Statistics | | | |
| R-squared | -0.208337 | Mean dependent var | | 1636305. |
| Sum squared resid | 8.40E+14 | Durbin-Watson stat | | 2.067996 |

According to the probe obtained from the above variables (all probes are smaller than 0.05) all explanatory variables have a statistically significant relationship with the dependent variable.

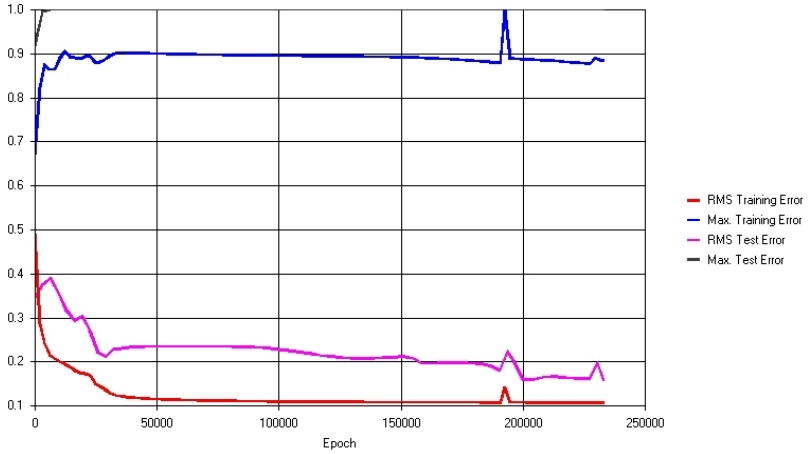


**Figure 1. RMS and maximum learning and test error**

Tests conducted show a significant correlation among the returns of the Fund Currency (inversely), inflation (direct link), liquidity (direct connection) and housing price index (inversely). Thus, first hypothesis, the efficiency of mutual funds and macro-economic factors is confirmed. Next top model was implemented by using neural network. Stopping the learning neural network model was determined based on the root mean square error of the test which is less than 0.1 and the duration of each test was determined after hundreds of learning. Keeping the learning situation was determined based on the minimum criteria (RMS test).

In the figure below, RMS and maximum learning and test error is shown. The upper curve in the lower diagram, RMS analysis shows at least 200,000 of its own value.

**Table 5. The results of the estimation of regression coefficients in the network**

| Variables | Estimated coefficients |
|---|---|
| X1? | 2.255254 |
| X2? | 5.263734 |
| X3? | 4.1379- |
| X4? | 0.094221 |
| X5? | 0.303982 |
| X6? | -4.21988 |

***Assessment process models***

To assess the applicability of a predictive model of a given time series, the measures of forecast errors will be used, if y and ŷ indicate the actual and the predicted variable at time t is the forecast error is defined as e = y-ŷ so for a period of time and the predicted value for n, measures are predicted.

**Table 6. Parameters of error evaluation models ANIFS, LARS and SVR**

| | |
|---|---|
| MSE (mean square error of prediction) | $MSE = \frac{\sum_{i=1}^{n}(e_i)^2}{n}$ |
| NMSE (normalized standard error of the mean square) | $NMSE = \frac{1}{n}\sum_{i}\frac{(\hat{y}_i - y_i)^2}{\bar{\hat{y}}_i \bar{y}_i}$ |
| MAD (mean standard deviation of the prediction error) | $MAD = \frac{1}{n}\sum_{i}(\hat{y}_i - \bar{\hat{y}}_i)^2$ |
| R2 (coefficient of determination) | $R^2 = 1 - \frac{SSE}{SSy}$ |

All the above data for daily, weekly and monthly is calculated. In order to identify the best model in terms of the accuracy of the criteria of MAD, MSE, NMSE MSE is to compare different models. The final model was designed as follows:

**Table 7. Final model based on the accuracy of the criteria**

| Model Name | MAD | MSE | NMSE | R2 |
|---|---|---|---|---|
| Yield least squares (regression) | 0.00086 | 0.0000017 | 0.000095 | 0.51320 |
| Nervation | 0.00089 | 0.0000018 | 0.0001 | 0.8997 |

The results show that the neural network with regression of explanatory power (R2) is less than the forecast error. The second hypothesis is that the "prediction error rate of return of mutual funds by using artificial neural network (ANN) approach is lower than predicted by the regression

model" is confirmed. The neural network model is used to explain the proper effect can predict the performance of funds.

**Discussion and Conclusion**

The main objective of this study was to define and design a model to predict the performance of mutual funds by using macroeconomic variables in the Tehran Stock Exchange. In this study the performance of 67 mutual funds in Tehran Stock Exchange on29 March 2013 were reviewed. Given the importance of these funds in the capital markets and the role of the fund's capital market development, this study looks interesting. Macroeconomic variables examined in this study include: oil prices, inflation, liquidity, exchange rate, gold price index and housing prices. The results showed that the index of housing prices and the exchange rate are inversely associated with the return of mutual funds. As well as other macroeconomic variables including oil prices, inflation, liquidity and efficiency that are directly related to the price of gold. The ANN model was designed to be higher than the regression model's predictive power.

**References**

Achsani, N., & H.G. Strohe (2002). Stock Market Returns and Macroeconomic Factors, Evidence from Jakarta Stock Exchange of Indonesia during 1990-2001, Universidad Potsdam, Wirtschaftsund Sozialwissenschaftliche Fakultät, Discussion Paper.

Anatolyev, S. (2008). A ten-year retrospective on the determinants of Russian stock returns. Research in International Business and Finance, 22(1): 56-67.

Azeez, A. A. & Yonezawa, Y. (2006). Macroeconomic factors and the empirical content of the Arbitrage Pricing Theory in the Japanese stock market. Japan and the World Economy, 18: 568–591.

Barber, B., Odean, T., & Zheng, L. (2005) . Out of sight, out of mind: The effects of expenses on mutual fund flows. Journal of Business, 78, 2095-2120.

Black, F., Michael C., & Scholes, J. (1972). The Capital Asset Pricing Model: Some Empirical Tests, NewYork: Praeger, 79-121.

Brealey, R., Myers, S., & Allen F. (2006). Principles of Corporate finance. Eighth edition, Boston: McGraw-Hill/Irwin.

Cao, C., Chang E., & Wang, Y. (2008). An empirical analysis of the dynamic relationship between mutual fund flow and market return volatility. Journal of Banking & Finance, 32: 2111-2123.

Cashman, G., Nardari, F., Deli, D., & Villupuram, S., (2008). Understanding the non-linear relation between mutual fund performance and flows, Working paper, Texas Tech University.

Chen, N-F, Roll, R., & Ross, R. (1986). Economic forces and the stock markets, Journal of Business, 59.

Chen, W. K., Y. J. Chen, & T. Ch. Chen, (2007). Using Efficiency Ratio to Measure Fund Performance, Journal of Asset Management,6:352–360.

Cox, J., Ingersoll, J., & Ross, S. (1985). An intertemporal general equilibrium model of asset prices, Econometrica, 53(2): 363–384.

DeBondt, Werner F. M., & Richard H. Thaler, (1987). Further evidence on investor overreaction and stock market seasonality, Journal of Finance, 42: 557–581.

Dinesh Kumar,G & Mihir, D. (2011). A study on the effect of macroeconomic variable on indian mutual funds, Journal of analytique, 8: 6–16

Droms, W. G. & D. A. Walker, (1994). Investment Performance of International Mutual Funds, Journal of Financial Research, 17, 1.

Elton, E.J., Gruber, M.J., Brown, S.J. & Goetzmann, W.N. (2003). Modern Portfolio Theory and Investment Analysis. Sixth Edition. John Wiley & Sons, New York.

Eskandari, R. (2011). Describing the design and bankruptcy prediction model in Tehran Stock Exchange, Ph.D. dissertation, University martyr Beheshti.

Fama, E. (1991). Efficient Capital Markets, Journal of Finance, 5.

Fama, E.F., & McBeth, J.D. (1973). Risk, return and equilibrium: empirical test, Journal of Political Economy, 71.

Fung H.G. & C.J. Lie (1990). Stock Market and Economic Activities: A Casual Analysis, Pacific-Basin Capital Markets Research, Amsterdam.

Geske R. & R. Roll (1983). The Fiscal and Monetary Linkage between Stock Returns and Inflation, Journal of Finance, 38 (1):7-33.

Gilles, R. & Leroy, S. F. (1991). On the Arbitrage Pricing Theory. Economic Theory, 1(3): 213–229.

Gjerde, O., & Saettem, F. (1999). Casual Relations among Stock Returns and Macroeconomic Variables in a Small, Open Economy, Journal of International Finance Markets Institutions and Money, 9: 61-74.

Goyal, A., & Welch, I. (2008). A comprehensive look at the empirical performance of equity premium prediction, Rev. Financ. Stud, 21(4): 1455 - 1508.

Greene, J., & Hodges, C. (2002). The dilution impact of daily fund flows on open-end mutual funds. Journal of Financial Economics, 65: 131-158.

Greene, Jason T., Charles W. Hodges & David A. Rakowski (2007). Daily Mutual Fund Flows and Redemption Policies, Journal of Banking and Finance, 31, 12

Gujarat, D. (2008). Foundations of econometrics. Tehran: Tehran University Publishing and Printing Institute. Fifth Edition.

Jensen, M. C., (1968). The Performance of Mutual Funds in the period 1945-1964, Journal of Finance, 23: 389-416.

Leigh, L (1997). Stock Return Equilibrium and Macroeconomic Fundamentals, "International Monetary Fund", Working Paper, 97(15): 1-41.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets, Review of Economics and Statics, 47: 13- 37.

McElroy, M.B., & Buremeister, E. (1988). Arbitrage pricing theory as a restricted nonlinear multivariate regression model: iterated nonlinear seemingly unrelated regression estimates, Journal of Business and Economic Statistics, 6(1): 29–42.

Morel, C. (2001). Stock selection using a multifactor model – empirical evidence from the French stock market, The European Journal of Finance, 7(4): 312–334.

Najand, M., & Rahman, R. (1991). Stock Market Volatility and Macroeconomic Variables: International Evidence, Journal of Multinational Financial Management, 1, 3.

Poon, S., & S.J. Taylor (1991). Macroeconomic Factors and the UK Stock Market, Journal of Business.

Pourzamani, Z., Rouhi, A. & Safari, A.M. (2010). The effect of environmental factors on the efficiency of fund management in Iran, Journal of Management, 42-61

Rai, R., & Fallah Pour S. (2004). Predicting financial distress (Financial Distress) companies using artificial neural networks (ANN). Tehran: Journal of Financial Research, 6 (17): 39- 70.

Ross, S., (1976). The Arbitrage Theory of Capital Asset Pricing, Journal of Economic Theory, 13.

Saeedi, A. & Moghaddasian, I. (2010). Evaluating the performance of common stock mutual funds, Exchange Quarterly, 3 (9): 5-24

Saeedi, A., G. & Mohseni, S. (2010). The factors affecting the efficiency Qhay fund investing in shares in Tehran Stock Exchange, Stock Exchange Quarterly, 3 (10): 123-141.

Securities and Exchange Organization, (2010). Financial Institutions, Securities Market Law Handbook, Publication and information services company stock, 152

Sharpe, W. F. (1966). Mutual Fund Performance, Journal of Business, 39:119-138.

Sharpe, W.F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk, Journal of Finance, 19: 309-327.