CHECKING THE FORECAST ABILITY OF ARBITRAGE PRICINGMODEL IN THE TEHRAN STOCK EXCHANGE

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Abstract: *Using the theory of financial economics toanalyze the country's capital market would beoptimal investment decisions. Investors are forming sought to identifyriskfactors Tehran Stock Exchange. Macro-economic factorsallaffect the company's stock. These factor sincrease the risk of fluctuation and variationin the index. The most effective* macroeconomic *variables GDP, inflation, exchange rates, revenues, operating costs and government building permits are issued as risk factors and are entered APT model. The study with the help of econometric techniques Johansson Juselius using statistical data between 1990 and 2012 long-term relationship between economic variables and output variables and coefficients Tehran Stock Exchange confirmed by GDP (22.34), revenues (3.49) and exchange rate (2.63) has a positive effect on the operating costs (5.92) and the issuance of building permits (0.08) and inflation (0.03) negative effect on the efficiency and the Tehran Stock Exchange Economic data between 2008 and 2012 as the forecast period for the model considered and evaluated the predictive model using two index root mean square forecast errors (RMSE) and mean absolute error (MAE), respectively (0.403) and (0.322), which confirms the efficiency of arbitrage theory.*

Key words: macroeconomic *indicators, efficiency Stock Exchange, Johansson Juselius econometric model, arbitrage pricingtheory.*

1. INTRODUCTION

Stock Exchange is one of the pillars of organized capital market and can focus capitaland putting them to work in the service of development; to achieve these goals depends on the performance of the stock exchange and capital market development. The samples which related to the create efficiencies, check the relationship of risk and return, and have introduced a variety of factors as

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dependent variables. Among the well-known pattern to determine the efficiency of the process is the pattern of APT (Arbitrage Pricing Model), which maintains the efficiency of securities under the influence of various factors on the macroeconomic level. Therefore the use of index securities market analytics, APT model with macroeconomic factors will be discussed. The results of this survey will help us to find effective macroeconomic variables; the models predict stock prices more convenient and useful for the securities market in the future of our country. Because most of the studies related tool dage, usually one-side deffect on returns has been variable, the study variables is a more effective use of test Johansen–Juselius for estimating statistical models and data as part of the sample and the remaining part is used as a model.

2. THEORETICAL FOUNDATIONSANDRESEARCH HISTORY

Tehran Stock Exchange official means of amarket in which to buy and sell stocks or government bonds or private institutions, under the terms of rules and regulations is done. Investors sought to determine the factors that affect their efficiency. APT model in recent years because of the simplicityand the assumptions areless restrictive than the other models is more important. In financial economics to determine efficiency mechanisms and the relationship between risk and return, patterns used single-factor and multi-factor models and APT model in the form of a multi-factor model is extracted and analyzed.

The Concept of Arbitrage Pricing Theory

Arbitrage is an opportunity which can be an asset in one market and simultaneously buy the same asset at a price in another market at a higher price to sell. In a labor market arbitrage opportunity does not exist or disappears quickly. After making unrealistic assumptions, the CAPM market portfolio and therefore are not allowed to test CAPM (according to theory) is impossible. After overcoming these problems Stephen Ross in 1976, APM (APT) introduced the empirical research study began. Assumptions arbitrage model (APT)

1. Full competition is in the capital market

2. Investors flee risk

3. Investors or their representatives have similar ideas about process efficiency before the assets are random.

4. There is the possibility of selling borrowed securities indefinitely.

5. Return on assets is determined by more than one common factor. Shipping algebraic equation for arbitrage theory (APT) Arbitrage pricing theory is based

on a multi-factor model. Based on the operating efficiencies of an asset at any time is a random variable, due to market conditions fluctuate around its expected return. Equation (APT) with the assumption that investors believe that the *i*-th asset returns by *k*-factor model is as follows:

$$R_{it} = E(R_{it}) + \beta_{i1}F_{1t} + \beta_{i2}F_{2t} + ... + \beta_{ik}F_{kt} + \varepsilon_{it}, \ i = 1, ..., N$$

Which in that R_{it} is the profit on asset *i* at time of *t*, $E(R_{it})$ expected return on assets of *i*, β_{ik} sensitivity of asset *i*, to a *k*-th, F_{kt} of k_{th} and ε_{it} is as disturbing. With $E(\varepsilon_i) = 0$, $E(\varepsilon_i\varepsilon_j) = 0$ when $j = i$ and $j \neq i$ is the expected return Property *i* is linearly related to β parameter

$$E(R_i) = R_f + \beta_{i1}\lambda_1 + \beta_{i2}\lambda_2 + ... + \beta_{ik}\lambda_k$$

$$E(\varepsilon_{it}^2) = S_i^2 < S^2, \ E(F_1^2) = 1,$$

$$E(\varepsilon_i) = E(F_s) = E(\varepsilon_i\varepsilon_j) = E(\varepsilon_i F_s) = E(F_s F_{s'}) = 0$$

$$s = s' = 1, 2, 3, ..., k$$

$$j = i = 1, 2, 3, ..., n$$

Where R_f yields on risk-free assets. λ_k price sensitive market to the *k*-th basic variable. APT asset pricing equation indicates that the expected return Risk Factors Property almost linear function is largely an economic system. However, if a risk-free asset yields R_f is available, then assume that $R_f = \lambda_0$, the above equation can be written as follows:

$$E(R_{it}) = \lambda_0 + \lambda_1\beta_{i1} + ... + \lambda_k\beta_{ik}$$

Selection of macroeconomic variables reason for selecting these variables

1. The Berkeley variables on aggregate demand as a result of the sale of businesses and ultimately affect their earnings stream, these variables are: gross domestic product (GDP), government spending (CC).

2. International economic variables that affect the domestic economy. Since oil is mainly foreign exchange income, so tax revenues from oil and gas exports as government revenues (GI) and free market exchange rate (EXR) is used.

3. The variables will be the indicator of economic instability, such as the rate of inflation (CPI), high inflation rates reduce investment risk and increase the long term.

4. *The number of building permits issued in urban areas (PAR):* the housing sector as a driver of economic activity has been variable size indicates the prospects for society.

5. *Index Total income:* Total income investors in the exchange of stock prices and conceded two stock dividend benefits than shopping.

The figure from April 1369 in Tehran's stock price index and dividend yields and the symbol Tepix (TEPIX) will be calculated and published. The index of 52 companies which at the time included all companies listed on the back. If the corporate symbol is closed or not traded for some times the price of the last transaction of the index is considering.

Former Research and Studies

Roll and Ross (1980) proposed the discussion of the APT test and showed that the market portfolio can be chosen as a common factor. Roll and Ross indicated that if the factors are independent of each other and the variance is equal to a time of transition matrices can no longer be changed. Roll and Ross in the second part of his article, the daily data asset in the period 1260 – used in the period of 1962-72 and first in the assets of 42 groups of 30 each (in alphabetical order) were using factor analysis in each group, load factors were estimated for each asset. In each group, the load factors and average arithmetic returnis a cross-sectional regression to estimate the risks and rewards they conducted a significantre view and concluded that there are five common factor so that the risk premium of 88.1 percent in the first 42 groups with 95% significance. The fifth factor is in the risk premium of 4.8% of 42 patients with 95% significance. Finally, there are only three operating at an acceptable level. Here only the significance of risk factors is important for the amount of risk premium is not viable, so the results do not exclude the APT. priestly (1996) APT estimates of economic variables due to the economic interpretation of particular importance. To check if this method to create the necessary conditions are common elements are compatible or not? A common factor in three ways:

(a) The first difference,

(b) time-series,

(c) Kalman filter method estimated and compare.

The first difference method common factors obtained are correlated, so conditions are not necessary, although the conditions established in the time series method, but this method is expected to cause errors. So it is possible in this way not only the Kalman filter to estimate the real APT's requirements and offers a forecast error of the least square error. Kalman filter method to estimate the mean square error of APT, lower than that of the first difference is less than or equal time series method. The number of common factors in the Kalman filters method and time series are equal. But the factors are different.

Christofer Gan *et al.* (2006)

New Zealand stock index and a set of seven interactions between economic variables to monthly data from January 1990 to 2003, using the same test collective economic variables, including inflation, exchange rate, GDP, money supply, Long-term interest rates, short-term interest rates and local retail price of oil Johansen co-integration test results showed that New Zealand stock price index and economic variables tested there a long-term relationship.

Ali Tayebnia and Davood Sourani (2012) examined the effect of economic factors on the Stock Exchange and evidence of arbitrage in Tehran's stock exchange. For this purpose, information on stock prices of 20 company's active exchange was used. In the first phase due to consumer prices, the price of coin, currency, money supply, imports SUR method dependent on the stock prices of 20 companies with the highest liquidity were regressed. The results of the sensitivity coefficients price coins removed. Then estimate the remaining factors did see a significant factor influencing factors, making arbitrage pricing theory was accepted in Tehran Stock Exchange.

Parivash Zahedi Tehrani and jalal sadeghi sharif (2012) to explain the causal relationship between economic factors Tehran Stock Exchange price index using vector error correction model and demonstrate causality between GDP and total liquidity indicator price exchange securities causal relationship exists and while inflation is not such a relationship.

Mohammad Ali Manny and abbas Asghari (2009) investigated the factors affecting the efficiency of Stock Exchange using time series and arbitrage theory with the help of multi-factor model of simultaneous equations with sensitivity seemingly unrelated companies to identify factors were undetectable changes Weather in market returns and inflation and cost of construction companies and has a positive effect on returns unpredictable changes in imports has a negative effect on the performance of listed companies.

Abde Tabrizi and Iman Jokar Tang e Karami (2006), based on a selective approach factor analysis using a sample basket of shares of companies listed on the stock exchange and economic factors affecting the economy during the period from April 1995 to March 2004, the two banks information about the monthly returns of the company's stock and the monthly change rate of macroeconomic indicators prepared and used. The results showed that stock returns cement production group companies affected by the exchange rate and stock returns index group companies of petroleum products, machinery and electrical appliances in Iran's stock exchange rate index, the liquidity of Iran's price sensitivity and arbitrage pricing theory, asset pricing theory, for not detected. According to previous studies and theoretical foundations hypothesis is: Iranarbitrage pricingmodelis suitablefor the capital market.

3. RESEARCH METHODOLOGY

The fundamental objective in terms of research, in terms of field position, a retrospective of time, since the data bit, the following generalization of the results and of inductive causal analysis, statistical data due to limitations of the data release, quarterly data from 1990: 01 to 2012: 04 is. The population of the investigation of the companies listed in Tehran Stock Exchange and macroeconomic variables.Approximately 70% of the sample size for the survey period and the remainder of the models used to evaluate the forecast period. So for a normal model to the reliability and unending process variables via the Dickey-Fuller test to determine the optimum lag model, economic model to determine the best commentator vector Johansson-Juseliusused econometric tests. Test hypotheses has done by help of Eviews and Microfit software.

4. DATA ANALYSIS

Reliability Test

Study the reliability and unending time series prediction of particular importance in the region. In case of persistent lack of study series to series it should be made permanent. Series when statistical characteristics, including mean and variance over time is constant and persistent call. At this stage it is discovered that changing the trend of stable or unstable. Dickey Fuller unit root test (ADF) to determine the reliability of a process of time series used. Perform unit root test to distinguish between a valid and lasting difference on the basis of a unit root test a range of hypotheses to test the unit root hypothesis for the absence.If the root unit is equal as one the variable is steady and if the root of the absolute value of the difference is less than one, then the difference is unstable. Dickey Fuller unit root tests have initially done with the assumption that intercepts and process. H_0 assuming that there is aneed to continue to test unit root is not rejected. If the unit root is equal as one the variable is steady and if the root of the absolute value of the difference is less than one, then the difference is unstable. Dickey Fuller unit root tests have initially done with the assumption that intercepts and process. H_0 assuming that there is a need to continue to test unit root is not rejected. H_0 be accepted if the parameter is significant when considering the critical value t and its critical value at 5% are available by Dickey Fuller review. Then test with intercept and process parameters can be done. If the significance of this parameter was rejected, Dickey-Fuller tests done without intercept and trend. H_0 assuming that there is a need to continue to test unit root is not rejected. H_0 be accepted if the parameter is significant when considering the critical value t and its critical value at 5% are available by Dickey Fullerreview. Then test with intercept and

process parameters can be done.If the significance of this parameter was rejected, Dickey-Fuller test done without intercept and trend. Since stretch marks are estimated coefficients logarithmic form, long-term relationship between the variables in the study of economic and overall price index will be logarithmic form. The results of the tests in Table 1 are as follows:

Table 1
Results of Augmented Dickey Fuller Unit Root Test Variables

Variable	Having the intercept and process		With intercept and no trend		Without intercept and process	
	Statistic	Prob	Statistic	Prob	Statistic	Prob
LGDP	–/605	0/97	/86	/99	3/20	/99
CPI	2/14	0/00	2/83	0/00	2/73	/99
LCC	–1/13	/91	–2/63	/09	3/10	/99
LPAR	–3/53	/04	–	–	–	–
LGI	–5/36	0/00	–	–	–	–
LEXR	/25	/99	–2/51	/11	1/43	/96
LTEPIX	–3/01	/13	–1/60	/47	1/41	/95

Source: The findings of this study and using the software package Eviews 7

The reliability test results show three variations of the logarithm of GDP, inflation costs, given the current state without intercept and process level I (0) is stable. Log variables revenues and building permits have been issued assuming the intercept and process level I (0) is stable. Variables LEXR, LTEPIX that in the end is not a test, Dickey Fuller must first difference they made and the variables in first differences I (1) The intercept and the end are, the test results Dickey Fuller Results for these variables in first differences in table 2 below.

Table 2
Variable Augmented Dickey Fuller unit root test results

	Having the intercept and process		With intercept and no trend		Without intercept and process	
	Statistic	Prob	Statistic	Prob	Statistic	Prob
LTEPIX	–3/79	0/02	–	–	–	–
LEXR	–5/54	0/00	–	–	–	–

Source: The findings of this study and using the software package Eviews 7

Determine the optimal lag variables Criteria

Based on the Akaike (AIC) and Schwarz Bayesian (SBC) and Hannan-Quinn (HQ) optimal number of variables was determined. The observation that a sample size of one hundred low-thrust ($n <\ = 100$) Schwarz Bayesian statistics and maximum the criteria more appropriate statistic shows the optimal. According

to the rule, $m = n \wedge (1/3)$ where m is the number of lags and n is the number of samples is proposed. Given the number of our model, the microfit software for four hypothetical interruptions during the test that best Schwarz Bayesian criterion two is optimal. Table 3 different statistical values for the 4 stop the show.

Table 3
To Determine Theoptimal Degree of VAR

The number of interruptions	AIC	SC	HQ
0	8/9277	9/1562	9/0182
1	–5/6644	–3/8365	–4/9401
2	–8/0564	–4/6292*	–6/6984
3	–8/3731	–3/3466	–6/3814
4	–8/9241	–2/2982	–6/2987

Estimation of Long-term Integration Relationship

The basic condition in using Johansson-Juseliusis that the variable of I (0) or maximum I (1) is. The co-integration relationship between the variables specific statistic by statistic maximum effect is determined. To determine the number of co integrating vectors, the proposed five Johansson of the most uptight the first model is bound to disappoint most is the fifth model to estimate. Then there are no vector integration hypothesis ($r = 0$), respectively, in our test. If the effect of this hypothesis was rejected based on the quantity of critical statistic in the second phase of the null hypothesis ($r = 1$) again so as not tying the most uptight most of our tests. The test r existence of Vectorintegration is tested against Vectorintegration of $r + 1$ co integrating vector is tested. R is the vector of co-integration test when it is accepted that quantity is smaller than the critical value l_{max}. This process stops when the null hypothesis is not accepted. If the statistics of the test of critical value Johansson–J use lius the 5% significance level is greater, the null hypothesis is rejected. In the case of co-integration relationship, based on arbitrary variables, normal operation is carried out on vectors and based on economic theory, integration vectors that have chosen better economic interpretation.

Table 4
Test to Determine the Vector of Integration Based on Statistics up to the Special Values

Null hypothesis	Opposite hypothesis	Computational statistics	Critical value at 95%
$R = 0$	$r = 1$	188/71	45/63
$R < = 1$	$r = 2$	65/42	39/83
$R < = 2$	$r = 3$	25/52	33/64
$R < = 3$	$r = 4$	17/56	27/42
$R < = 4$	$r = 5$	14/07	21/12
$R < = 5$	$r = 6$	6/55	14/88
$R < = 6$	$r = 7$	0/34	8/07

Table 5
Test to Determine the Vector of Integration Based on the Statistical Effect

Null hypothesis	Opposite hypothesis	Computational statistics	Critical value at 95%
R = 0	r > = 1	318/20	124/62
R < = 1	r > = 2	129/48	95/87
R < = 2	r > = 3	64/06	70/49
R < = 3	r > = 4	38/53	48/88
R < = 4	r > = 5	20/97	31/54
R < = 5	r > = 6	6/89	17/86
R < = 6	r > = 7	0/34	8/07

Based on the results contained in the table (4) statistics show that the maximum amount for a maximum of two co integrating vector between the vector model is more consistent with economic theory and its normalized form as follows See, since the variables in the model are logarithmic form (except inflation), are estimated coefficients represent elasticity.

LTEPIX = 22.34 LGD – 0.03 CPI – 0.08 LPAR – 5.92LCC + 3.49 LGI + 2.63 LEXR

– Increase GDP by one percent, leading to an increase in the price index of Tehran Stock Exchange to the 22.34 percent.

– Increase in the rate of inflation leads to lower unit price index of Tehran Stock Exchangeon the 0.03 units.

– Increase in the number of building permits issued by municipality's percent in urban areas, leading to a decrease inthe price index of Tehran Stock Exchange is 0.08 percent.

– An increase ingovernments pending leads to lower prices by one percent of the Stock Exchange of 5.92 percent.

– Increase state revenues by one percent leads to an increase in the price index of the Stock Exchange to 3.49 percent.

– Increase the official exchange rate of one percent leads to an increase in the price index of the Stock Exchange to 2.63 percent.

4.4. Stockmarket Price Index Prediction Model Based on Arbitrage

Forecast model for the study to evaluate the performance of the forecast period and period split. Using the soft ware microfiche period 1990 : 01 to 2007 : 04, (approximately 70% ofthe sample) were used to estimate the model using the Johansen-Juselius and the rest of the period (2008 : 01 to 2012 : 04) of the remaining sample approximately 30% of the observations are used to assess the

predictive power of the model-arbitrage that results between the actual values with the values predicted by the model arbitrage tables and graphs as follows:

Observation	Actual	Prediction	Error
2008 Q1	9.3560	9.3321	.023892
2008 Q2	9.3768	9.4547	–.077927
2008 Q3	9.0890	9.5947	–.50578
2008 Q4	8.9829	9.7229	–.73999
2009 Q1	9.1332	9.8519	–.71866
2009 Q2	9.3459	9.9430	–.59713
2009 Q3	9.4153	10.0161	–.60078
2009 Q4	9.4364	10.0757	–.63922
2010 Q1	9.5650	10.1337	–.56869
2010 Q2	9.8208	10.1688	–.34803
2010 Q3	9.8175	10.1951	–.37754
2010 Q4	10.0560	10.2222	–.16617
2011 Q1	10.1339	10.2559	–.12203
2011 Q2	10.1644	10.2812	–.11676
2011 Q3	10.1062	10.3055	–.19935
2011 Q4	10.1622	10.3380	–.17581
2012 Q1	10.2132	10.3799	–.16673
2012 Q2	10.1722	10.4185	–.24630
2012 Q3	10.4846	10.4575	.027062
2012 Q4	10.5464	10.5045	.041930

Multivariate dynamic forecasts for the level of LTEPIX
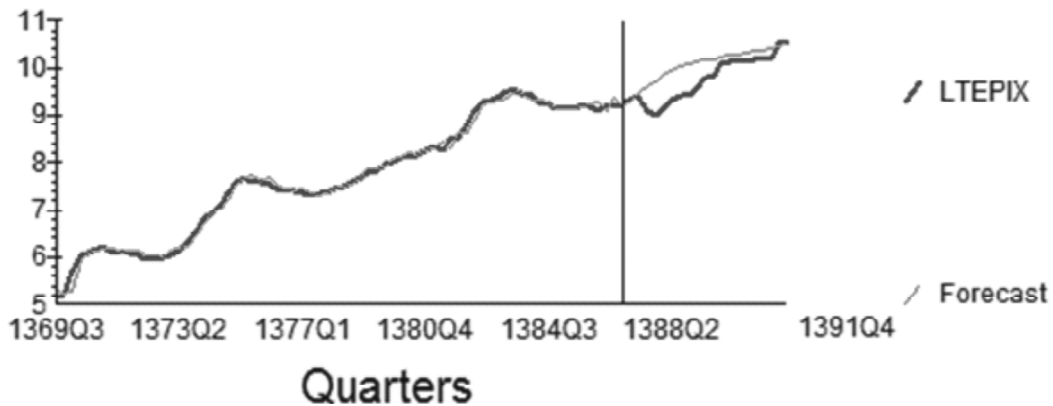
Also, to evaluate prediction models also has been used predicted the index root mean square error (RMSE), mean absolute error (MAE). Indices are calculated as follows:

$$MAE = \sum_{t=T+1}^{T+h} \left| (\hat{y}_t - y_t)^2 / h \right|$$

$$RMSE = \sqrt{\frac{1}{h} \sum_{t=T+1}^{T+h} (\hat{y}_t - y_t)^2}$$

Where and are respectively the actual values and the predicted fluctuations. Thus, in paren these sindicates the prediction error. The period represents the second period (retrospective forecast period) is. Based onthese criteria, the greater the ability of the model to predict the prediction erroris lessis more. Therefore, a model that has lower RMSE, the better the prediction will fluctuate.

	Volume estimates	Forecast period
	1369 : 01 to 1386 : 04	1387 : 01 to 1391 : 04
Mean absolute	0.072	0.322
Root mean sum squares	0.100	0.403

5. CONCLUSION

The study evaluated according to the conditions and limitations of them odel predictions with the index forecast mean square error (RMSE) and the mean absolute error (MAE) which, respectively (0.403), and (0.322) and minimally these errors seem to FB Stop of the forecast. Johansen J uselius test long-term relationship between economic variables and returns Tehran Stock Exchange price index of Tehran Stock Exchange approval and changes to all variables other than inflation and building permitsat as tretch. And the most positive impacton the GDP, government revenues and foreign exchange rates, and variable operating costs, the number of building permits issued and the inflation rate has been negative effect. The results suggest a successor and rival of Iran's economy is the housing sector to the capital markets. Related research by Abdo Tabrizi and tight barley faith Cream (2005) selective approach based on factor analysis using a sample basket of stocks listed on Tehran Stock Exchanger ate monthly change in macro-economic variables that the arbitrage the orya good mode lIran's capital market and Tayebnia and Sourani (2012) used the value of shares listed 20 companies with high liquidity and macroeconomic factors SUR method and with the elimination of six meaningless, efficiency arbitrage model confirmed. However, it is suggested that, given the size of the stock market and stronger

economy in the future it can be Compass Stock Exchange shows that the evolution of the economy is necessary through reaction of the market economic authorities Country Results decisions capital track. It is recommended that future researchers in their study because the price of their turnover in the stock market there are companies that own the major trading changes to the index lead. However, in most studies of purely economic factors appropriate model to be designed so that the analysis of both economic and political factors. The implicit assumption of this study is based on the linear model and macroeconomic factors used in future research suggested that the non-linear models and models based on microeconomic be used in future studies using different macroeconomic variables And the more comprehensive models and the use of two sets of samples, the number of samples used to estimate the model and another sample to verify the results of the first sample.

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