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The Effects of Macroeconomic Factors on Stock Return of Energy Sector in Shanghai Stock Market

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Abstract- The purpose of this study is to study the impact of macroeconomic factors on return of energy sector in Shanghai stock market (SEE), which are inflation rate, money supply (M2), exchange rate, industrial production, bond, exports, imports, foreign reserve and unemployment rate. The secondary data, collected from People's Bank of China and the National Bureau of Statistics of China, were for the period beginning January 2005 to December 2011 with no any missing monthly observations. The samples are selected from Shanghai Stock Exchange (SEE) to present the energy industry. The findings reveal that exchange rate, exports, foreign reserve and unemployment rate have effects on the stock return of energy sector in Shanghai stock market.

Index Terms- Arbitrage Pricing Theory (APT), Macroeconomic Factor, Shanghai Stock Exchange, Energy Sector

I. INTRODUCTION

The arbitrage pricing theory (APT) has been applied to test the impact of macroeconomic forces on stock return worldwide. Initially, the APT was applied by Ross (1976, 1977) to explain stock return in U.S market through the examination of seven macroeconomic variables which were terms structure, industrial production, risk premium, inflation, market return, consumption and oil price (Chen, Roll and Ross, 1986). The findings revealed the significant association between the macroeconomic variables and stock return especially in terms of industrial production, changes in risk premium, and twist in the yield curve. Hence, APT has been applied to test the expected return of investment and the impact of macroeconomic factors on the investment.

The purpose of this study is to investigate the performance of APT in Shanghai Stock Exchange (SEE) and to discover the association between a set of macroeconomic variables and stock return. In the study, nine macroeconomic factors are tested which are inflation, money supply (M2), exchange rate, industrial production, bond, export, import, foreign reserve and unemployment rate to price the stocks o SEE. 10 companies from energy sector in SEE were selected from January 2005 to December 2011 on monthly base.

The study consists of six sections. The first section briefly presents the background of the study. The section two discusses literature review and the findings from previous studies. Section three provides data sources. Section four explains the research methodology. Section five provides the research finding, and section six concludes.

II. LITERATURE REVIEW

The Arbitrage Pricing Theory (APT) was initiated by Ross (1976) which is an alternative to the Capital Asset Pricing Model (CAPM). APT is a one-period model that explains the consistency of the stochastic properties of returns of capital assets with a variable structure (Ross, 1976; Huberman and Wang, 2005). According to Ross, the returns of an asset can be predicted through the association between the asset and other risk factors. The relationship between the return of a portfolio and the return of an asset is predictable. Based on the APT, a linear relation between expected returns of investments and their covariance with other random factor was defined (In the CAPM, the covariance is with the market portfolio's return.) The covariance is identified as a measurement of risk that investors cannot avoid by diversification. The slope coefficient in the linear relation between the expected returns and the covariance is defined as a risk premium (Huberman and Wang, 2005).

The Arbitrage Pricing Theory (APT) has been applied by various scholars to analyze the association between stock return and macroeconomic variables. G**Ü**nsel and Çukur (2007) applied APT to study the impact of macroeconomic variables on stock return in the U.K. The seven macroeconomic variables were investigated that were the term structure of interest rate, risk premium, exchange rate, money supply and inflation, and the data were collected from 1980 to 1993 in a monthly base. Durbin-Waltson (D-W) was applied to test the serial correlation of residuals, and the results showed that there was no evidence for serial correlation. Moreover, regression results revealed differences among industry portfolios. Özcam (1997) studied the impact of seven macroeconomic variables on asset return in Istanbul Stock Exchange (ISE) by applying APT, in which a regression model with two step testing methodology was implemented. The findings revealed that there was a significant relationship between beta coefficients of expected macroeconomic variables and asset return. Clare and Thomas (1994) studied the impact of 18 macroeconomic variables on stock returns in the U.K. The findings revealed that oil price, retail price index, bank lending and corporate default risk had significant influence on stock returns. Hamao (1988) applied APT in Japanese stock market, and the stock return was significantly affected by macroeconomic variables that were

inflation, risk premium and interest rate. Wongbangpo and Sharma (2002) investigated the association between macroeconomic variables and stock return in five South East Asian countries that are Indonesia, Malaysia, Philippines, Singapore and Thailand. A summary of macroeconomic factor applied APT test by scholars is indicated in Table 1 as below:

Table 1. Macroeconomic variables used in previous APT test

Exchange Rate	Özcam (1997); Türsoy, Günsel and Rjoub (2008); Ibrahim and Aziz (2003); Priestley (1996); Brown and Otsuki (1990); Wongbangpo and Sharma (2002); Ramadan (2012); G**Ü**nsel and Çukur (2007)
Industry Production	Chan, Roll and Ross (1996); Chen and Jordan (1993); Özcam (1997); Roselee and Fung (2009); Humple and Macmillan (2007)
Inflation	Türsoy, Günsel and Rjoub (2008); Roselee and Fung (2009); Humple and Macmillan (2007); Wongbangpo and Sharma (2002); Altay (2003); Kandir (2008); Chen and Jordan (1993); G**Ü**nsel and Çukur (2007)
Bond	Chan, Roll and Ross (1996); Gultekin and Rogalski (1984)
Money supply (M2)	Türsoy, Günsel and Rjoub (2008); Humple and Macmillan (2007); Ibrahim and Aziz (2003); Priestley (1996); Brown and Otsuki (1990); Wongbangpo and Sharma (2002); Altay (2003); Kandir (2008); G**Ü**nsel and Çukur (2007)
Export	Türsoy, Günsel and Rjoub (2008); Beenstock and Chan (1988);
Import	Türsoy, Günsel and Rjoub (2008); Altay (2003); Kandir (2008)
Foreign reserve	Türsoy, Günsel and Rjoub (2008);
Unemployment rate	Türsoy, Günsel and Rjoub (2008); Clare and Thomas (1994); Teschner, Stathel and Weihardt (2011)

III. DATA SOURCE

The sample in this study contains firms accessible from energy sector in Shanghai Stock Exchange (SSE) for the period beginning January 2005 to December 2011 with no any missing monthly observations. For the macroeconomic variables, the research obtains the data from the People's Bank of China and the National Bureau of Statistics of China. Ten firms from energy sector were chosen to represent the whole industry in SEE, and nine macroeconomic factors were selected to study about their impact on stock return of energy sector. The measurements of selected macroeconomic factors are listed in Table 2:

Table 2. Macroeconomic Factors

Symbol	Factors	Measurement
F_1	Inflation	Log(INF) – Log(INF (-1))
F_2	Money Supply (M2)	Log(MS) – Log(MS(-1))
F_3	Exchange Rate	Log(USD) –Log(USD(-1))
F_4	Industrial Production	Log(ID) – Log(ID(-1))
F_5	Bond	Log(BOND) – Log(BOND(-1))
F_6	Export	Log(EXPORT) – Log(EXPORT(-1))
F_7	Import	Log(IMPORT) – Log(IMPORT(-1))
F_8	Foreign Reserve	Log(FR) – Log(FR(-1))
F_9	Unemployment Rate	Log(UNEMP) – Log(UNEMP(-1))

IV. METHODOLOGY

There are two sessions in this study. The first session is to apply ADF (augmented Dickey-Fuller) model (Dickey & Fuller, 1979) in order to test a unit autoregressive root in this study. The second session is to apply APT model which aims to investigate stock return of energy sector in Shanghai stock market through the examination of seven macroeconomic variables which are inflation, the exchange rate, the unemployment rate, money supply, imports, exports, foreign reserve, bond and the industrial production.

Unit Root Test According to Dickey and Fuller(1979), ADF (augmented Dickey-Fuller) that is used to test a unit autoregressive root studies the null hypothesis H_0 : $\delta=0$, which is in opposition to the alternative H_1 : $\delta<0$ in terms of regression:

$$\Delta Y_t = \beta_0 + \delta Y_{t-1} + \gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta Y_{t-2} + \ldots\ldots + \gamma_p \Delta Y_{t-p} + u_t$$

From null hypothesis aspect, Y_t presents a stochastic movement, but from alternative hypothesis aspect, Y_t becomes stationary. Then ADF statistics is to test $\delta=0$ through OLS *t*-statistic.

However, from alternative hypothesis aspect, if Y_t is stationary which seems to be a deterministic linear time tendency, then this phenomenon (t means the number of the observation) should be attached to be an extra regressor, under which the Dickey-Fuller regression is developed to be:

$$\Delta Y_t = \beta_0 + \alpha t + \delta Y_{t-1} + \gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta Y_{t-2} + \ldots\ldots + \gamma_p \Delta Y_{t-p} + u_t$$

Where, α is unknown coefficient, and ADF statistic is the OLS t-statistic testing $\delta=0$

The APT Model . The following model is applied for this study to test the stock return:

$$\mathbf{R_i = b_{i0} + b_{i1}F_{1i} + b_{i2}F_{2i} + b_{i3}F_{3i} + b_{i4}F_{4i} + b_{i5}F_{5i} + b_{i6}F_{6i} + b_{i7}F_{7i} + b_{i8}F_{8i} + b_{i9}F_{9i} + \in_i}$$

Where $\mathbf{R_i}$ is actual return on portfolio I, $\mathbf{b_i}$ is the reaction coefficient that evaluates the change in portfolio return in risk factors, and $\mathbf{F_i}$ represents the macroeconomic variables. There are 9 macroeconomic factors that are applied in this study as follow:

F_1: The inflation rate
F_2: The money supply (M2)
F_3: The exchange rate
F_4: The industrial production
F_5: Bond
F_6: Exports
F_7: Imports
F_8: Foreign reserve
F_9: The unemployment rate

V. DATA ANALYSIS

In this session, the results of unit root test, correlation matrix and estimate equation will be provided as below:

5.1 Stationary analysis (Unit root tests)
The following two tables illustrate the results of before and after running ADF. Table 3 shoes the results of eight macroeconomic variables are non-stationary except unemployment rate. In order

to apply regression, the research needs to modify the date by using 1st difference to make the data stationary. Table 4 shows that the results are adjusted to be stationary, by which the regression test can be used for the further demonstration.

Table 3. Augmented Dickey-Fuller Test Results (Before changed data)

Macroeconomic Factors	Augmented Dickey-Fuller test statistic	Critical Value at 1%of significant level	Stationary
Inflation	-2.827378	-3.514426	No
Money Supply	3.955960	-3.511262	No
Exchange Rate	-1.704890	-3.511262	No
Industrial Production	-4.046746	-3.511262	Yes
Bond	-1.784254	-3.512290	No
Export	-1.682768	-3.512290	No
Import	-0.319938	-3.513344	No
Foreign Reserve	1.092471	-3.511262	No
Unemployment Rate	-2.115220	-3.511262	Yes

Table 4. Augmented Dickey-Fuller Test Results (After changed by using Log difference)

Macroeconomic Factors	Augmented Dickey-Fuller test statistic	Critical Value at 1%of significant level	Stationary
Inflation	-4.040812	-3.525618	Yes
Money Supply	-8.848371	-3.512290	Yes
Exchange Rate	-9.060260	-3.512290	Yes
Industrial Production	-9.518754	-3.513344	Yes
Bond	-6.619521	-3.512290	Yes
Export	-10.70510	-3.513344	Yes
Import	-10.31210	-2.897678	Yes
Foreign Reserve	-12.54991	-3.514426	Yes
Unemployment Rate	-7.955958	-3.512290	Yes

5.2. Correlation Matrix

Table 5. Correlation Matrix

	X_INFLATI	X_RET_MC	X_RET_EX	X_INDUST	X_RET_BO	X_RET_EX	X_RET_IM	X_RET_FO	X_RET_UNEMPLOYEMENTRATE
X_INFLATI	1	-0.04048	-0.09631	0.091021	-0.05139	0.058494	0.061303	0.252283	-0.1304
X_RET_MC	-0.04048	1	0.02971	-0.09605	-0.10907	-0.19685	-0.19195	-0.13647	0.21951
X_RET_EX	-0.09631	0.02971	1	-0.00611	0.276553	-0.00904	-0.00958	0.115965	0.005199
X_INDUST	0.091021	-0.09605	-0.00611	1	0.052464	0.004376	0.10992	0.022418	0.116986
X_RET_BO	-0.05139	-0.10907	0.276553	0.052464	1	-0.00507	-0.01443	0.070629	0.045519
X_RET_EX	0.058494	-0.19685	-0.00904	0.004376	-0.00507	1	0.27244	0.014768	-0.17648
X_RET_IM	0.061303	-0.19195	-0.00958	0.10992	-0.01443	0.27244	1	0.135938	-0.09929
X_RET_FO	0.252283	-0.13647	0.115965	0.022418	0.070629	0.014768	0.135938	1	-0.2058
X_RET_UN	-0.1304	0.21951	0.005199	0.116986	0.045519	-0.17648	-0.09929	-0.2058	1

As indicated in Table 5, all the correlation coefficient values of macroeconomic factors are less than 0.79, which means that there is no problem of Multicollinearity in this study.

5.3. Regression Result

Table 6 and Table 7 summarize the findings of the null hypothesis in this study. The regression model is tested by applying ordinary least squares from the period of January 2005 to December 2011 for all macroeconomic variables. As indicated in Table 7 above, there are 4 hypotheses that reject null hypothesis at 1%, 5% and 10% significance level at 12 months lagged. It means that, exchange rate, exports, foreign reserve and unemployment rate have effects on the stock return of energy sector in Shanghai stock market.

Table 6. Result of Estimate Equation

Dependent Variable: ENERGY
Method: Least Squares
Date: 08/13/12 Time: 20:53
Sample (adjusted): 2005M02 2011M12
Included observations: 83 after adjustments
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.055093	0.024189	-2.277627	0.0257
X_INFLATION	0.985024	1.783360	0.552342	0.5824
X_RET_MONEYSUPPLY	0.820614	1.089509	0.753196	0.4538
X_RET_EXCHANGERATE	0.060502	0.008714	6.942830	0.0000
X_INDUSTRIALPRODUCTION	0.043846	0.050286	0.871926	0.3861
X_RET_BOND	0.026543	0.163792	0.162053	0.8717
X_RET_EXPORTS	-0.032617	0.009481	-3.440235	0.0010
X_RET_IMPORTS	0.043028	0.089835	0.478961	0.6334
X_RET_FOREIGNRESERVE	2.142004	0.847217	2.528283	0.0136
X_RET_UNEMPLOYEMENTRATE	1.293627	0.671917	1.925278	0.0581

R-squared	0.212962	Mean dependent var	0.002365
Adjusted R-squared	0.115930	S.D. dependent var	0.112801
S.E. of regression	0.106061	Akaikeinfo criterion	-1.537026
Sum squared resid	0.821169	Schwarz criterion	-1.245600
Log likelihood	73.78659	F-statistic	2.194760
Durbin-Watson stat	2.330537	Prob(F-statistic)	0.031919

Table 7: Summery of Hypothesis Test

Null Hypothesis Statement	Significant level	Result
H1o: Inflation does not have effect on stock return energy sector in SEE stock return	0.5824	Fail to reject Ho
H2o: Money Supply (M2) does not have effect on stock return of energy sector in SEE	0.4538	Fail to reject Ho
H3o: Exchange rate does not have effect on stock return of energy sector in SEE	0.0000***	Reject Ho
H4o: Industrial production does not have effect on stock return of energy sector in SEE	0.3861	Fail to reject Ho
H5o: Bond does not have effect on stock return of energy sector in SEE	0.8717	Fail to reject Ho
H6o: Exports does not have effect on stock return of energy sector in SEE	0.0010**	Reject Ho
H7o: Imports does not have effect on stock return of energy sector in SEE	0.6334	Fail to reject Ho
H8o: Foreign reserve does not have effect on stock return of energy sector in SEE	0.0136**	Reject Ho
H9o: Unemployment rate does not have effect on stock return of energy sector in SEE	0.0581*	Reject Ho

Note: **** P< .001, ** P<.005, * P<.1*

VI. CONCLUSIONS AND DISCUSSIONS

The research findings from Hypothesis 3, Hypothesis 6, Hypothesis 8 and Hypothesis 9 proved that exchange rate, exports, foreign reserve and unemployment rate have impact on return of energy sector in SEE.

Hypothesis 3 indicates that exchange rate affects stock return of energy sector at 1% significant level. The coefficient value (0.060502) shows that CNY/USD exchange rate has positive relationship with stock return of energy sector in SEE. The stock return of energy sector increases 0.060502 points as Chinese currency (CNY) is depreciated against US dollar 1 point

Hypothesis 6 indicates that exports rate has impact on stock return of energy sector at 5% of significant level. A negative coefficient value (-0.032617) implies a negative direction between exports and stock return, which means that the stock return of energy sector decrease 0.032617 point whenever exports increase 1 point.

Hypothesis 8 indicates that foreign reserve has impact on stock return of energy sector at 5% of significant level. The coefficient value (2.142004) represents a positive relationship between foreign reserve and stock return. The stock return of energy sector increases 2.142004 points as foreign reserve increase 1 point.

Hypothesis 9 shows that unemployment rate has impact on stock return of energy sector at 10% of significant level. The coefficient value (1.293627) represents a positive relationship between unemployment rate and stock return. The stock return of energy sector increases 1.293627 points as unemployment rate increases 1 point.

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