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THE INTERACTIONS BETWEEN S&P500 AND 10-YEARS TREASURY BOND RETURNS IN THE US

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ABSTRACT

In literature, impacts of macroeconomic factors on stock market and bond possess huge amount of studies. However, interaction between stock market yield and bond yield does not have prevalent studies. Therefore, the main purpose of this study is to analyze the interactions between S&P500 and 10-years tresury bonds in U.S. The study contains the period between 1985 and 2011. According to the empirical results of this study, while bond returns do not Granger cause to S&P500 returns, S&P500 returns do Granger cause to bond returns. That is, past returns of S&P500 to forecast the next day returns of bond return. Before applying Granger Causality test, the staionary of the variables is being tested via Augmented Dickey-Fuller (ADF), unit root tests are being examined and regression equation is being used.

1. INTRODUCTION

Stock market and bond market indicators play an eesential role on estimation of economic situation and investment since while stock market indicates the situation of real and financial sector by announcing its index, bond market leads to change of some factors such as interest rate. The best example of change because of bond is interest rate. It indicates that bond and stock market yield play an important role on macroeconomic indicators.

Furthermore,investors reach information and access the investment system easily thanks to developing financial markets and technology. It enables investors to have advantage for investment process. Institutional and individual investors desire to build profitable portfolio. Therefore, these investors use some techniques in order to reach profitability such as technique and fundamental analysis. They benefit from historical data, Daily news and information of different types of variable about financial markets. In recent years, bond and stock market yields are very important indicator for investment decision. Most of investors consider these vairable and they decide which financial instrument they will buy or sell. The reason why investors focus on some indicators such as bond and stock market return is probability of interaction between these variable. Therefore, in this study, interaction between bond and stock market return for estimation of each other instead of impacts on macroeconomics.

2. LITERATURE REVIEW

This section briefly reviews some important works carried out in the domain of interactions stock market and bond market.

Blume et al. (1991), Cornell and Green (1991) and Fama and French (1993) found positive but statistically significant association between bond returns and stocks. Shiller and Baltratti

(1992), possess finding abot bond and stock return correlation. Finding is the present value model leads positive correlation between bond and stock return. Shiller and Beltratti (1992), Campbell (1993) and Kwan (1996) indicate that there is an negative correlation between bonds and stocks. McQueen and Roley (1993), found an important relationship between macroeconomic news and stock prices in terms of industrial production, inflation and the unemployments rate. Kwan (1996), investigate the relationship between stock return and bonds. Findings show that stocks return possess negative effect on bond yields. Lim et al. (1998), focusing on the interaction between stock market and bond market, find existance of bi-directional causality between two variables. Jones, Lamont and Lumsdaine (1998) focused on government bond returns of varying maturity by using GARCH models. The finding is conditional volatility is not caused by macroeconomic releases. Fleming, Kirby and Ostdiek (1998), improve a model forecesting relationship among the stock, bond, and money markets. Li (2002), indicates that shocks of inflation lead to opposite direction on bond and stocks. Campbell and Taksler (2002) found an empirical interaction between the volatility of stock returns and bond yields. Longstaff et al. (2003) focus on U.S markets by examining Granger causality between changes of bond, changes of CDS spread, credits spreads and stock returns. Finding Show that stock markets and CDS markets lead bond markets. Ilmanen (2003), found that correlation between bond and stock become negative from positive due to economic situation and inflation. Wilson (2004) and Yang et al. (2009), found dynamic relationship between bonds and stock markets in U.S and U.K by using data from 1855 to 2001. Marquering (2005), investigate the covariance between stocks and bonds due to the kind of shocks by using GARCH model. The finding is that negative news for two markets follow by a greater covariance between them.

3. DATA AND METHODOLOGY

3.1. Data

This study tests the granger cause interaction between S&P500 and 10-years tresury bonds for period between 31.01.1985 and 31.08.2011. The data consists of monthly S&P500 yield and 10-years tresury bonds yield. Aim of this study is to measure whether bond yield Granger Cause yield of stock returns and vice versa. Provided that one of variables Granger Cause another variable, it will mean that variable which has Granger Cause is capable of estimate the another variable.

Before measurement of Granger Cause, data will be examine some tests such as unit root, Dickey- Fuller Test, normality test, White test and regression analysis. Unit root tests will examine the stationarity, White tests will examine the heteroscedasticity, normality tests examine normal distrubution and regression analysis examine relationship between two variables. Autocorrelation will be examined via Durbin – Watson Statistic.

3.2. Econometric Methodology

This study aims to investigate probablibity of forecast between S&P500 and 10-years tresury bonds. In this part, tables which indicates results in terms of unit root, Dickey- Fuller Test, normality test, White test, regression analysis and Granger Cause will be commented.

ADF Unit Root Test (Stationary Test)

This step is looking for an answer about stationarity of S&P 500 and 10-years tresury bonds. Provided that there is a unit root, data is not stationary. In case of being unit root, data should be adjusted as stationary. Unit root tests for 500 and 10-years tresury bonds are shown below.

TABLE 1: ADF UNIT ROOT TEST FOR S&P500

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.198302	0.9357
Test critical values:	1% level	-3.448943	
	5% level	-2.869629	
	10% level	-2.571148	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SP500(-1)	-0.000981	0.004949	-0.198302	0.8429
C	5.620164	4.840902	1.160974	0.2465

R-squared	0.000114	Mean dependent var	4.767960
Adjusted R-squared	-0.002776	S.D. dependent var	41.51254
S.E. of regression	41.57012	Akaike info criterion	10.29837
Sum squared resid	597914.0	Schwarz criterion	10.32051
Log likelihood	-1789.917	Hannan-Quinn criter.	10.30719
F-statistic	0.039324	Durbin-Watson stat	1.844469
Prob(F-statistic)	0.842925		

MacKinnon (1996) one-sided p-values is greater than 0,05 (0,9357>0,05). Therefore, null hypothesis is accepted (S&P500 has a unit root) and it means that S&P500 is not stationary. Furthermore, when prob(F-statistic) is observed, the result is not signicifant since value equals 0,842925 (p>0,05).

TABLE 2: ADF UNIT ROOT TEST FOR BOND

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.197526	0.2077
Test critical values:	1% level	-3.448943	
	5% level	-2.869629	
	10% level	-2.571148	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BOND(-1)	-0.016095	0.007324	-2.197526	0.0286
C	0.067493	0.044584	1.513833	0.1310

R-squared	0.013765	Mean dependent var	-0.023937
Adjusted R-squared	0.010914	S.D. dependent var	0.300532
S.E. of regression	0.298888	Akaike info criterion	0.428233
Sum squared resid	30.90950	Schwarz criterion	0.450372
Log likelihood	-72.51246	Hannan-Quinn criter.	0.437047
F-statistic	4.829123	Durbin-Watson stat	1.791894
Prob(F-statistic)	0.028645		

MacKinnon (1996) one-sided p-values is greater than 0,05 (0,2077>0,05). Therefore, null hypothesis is accepted (BOND has a unit root) and it means that BOND is not stationary.

Moreover, when prob(F-statistic) is observed, the result is signicifant since value equals 0,028645 (p>0,05).

Bond and stock returns possess unit root. For this reason, they will be taken first differences then unit root (stationarity) test will be checked again. Results and tables are being shown below.

TABLE 3: ADF UNIT ROOT TEST FOR S&P500 (AFTER FIRST DIFFERENCE)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.24634	0.0000
Test critical values:	1% level	-3.448998	
	5% level	-2.869653	
	10% level	-2.571161	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLSP500(-1)	-0.926061	0.053696	-17.24634	0.0000
C	0.006182	0.002436	2.537136	0.0116

R-squared	0.462982	Mean dependent var	-3.96E-05
Adjusted R-squared	0.461425	S.D. dependent var	0.061164
S.E. of regression	0.044887	Akaike info criterion	-3.363602
Sum squared resid	0.695112	Schwarz criterion	-3.341416
Log likelihood	585.5850	Hannan-Quinn criter.	-3.354768
F-statistic	297.4363	Durbin-Watson stat	1.993145
Prob(F-statistic)	0.000000		

After taking first diferrence, MacKinnon (1996) one-sided p-values is less than 0,05 (0,0000<0,05). Therefore, null hypothesis is rejected (S&P500 has no unit root) and it means that S&P500 is stationary. Furthermore, when prob(F-statistic) is observed, the result is signicifant since value equals 0,000000 (p<0,05).

TABLE 4: ADF UNIT ROOT TEST FOR S&P500 (AFTER FIRST DIFFERENCE)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.29996	0.0000
Test critical values:	1% level	-3.449053	
	5% level	-2.869677	
	10% level	-2.571174	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLBOND(-1)	-1.099094	0.071836	-15.29996	0.0000
D(DLBOND(-1))	0.196409	0.053145	3.695729	0.0003
C	-0.004491	0.003494	-1.285222	0.1996

R-squared	0.479718	Mean dependent var	-0.000133
Adjusted R-squared	0.476685	S.D. dependent var	0.089548
S.E. of regression	0.064779	Akaike info criterion	-2.627027
Sum squared resid	1.439353	Schwarz criterion	-2.593676
Log likelihood	457.4757	Hannan-Quinn criter.	-2.613747
F-statistic	158.1292	Durbin-Watson stat	1.955793

Prob(F-statistic)	0.000000

After taking first difference, MacKinnon (1996) one-sided p-values is less than 0,05 (0,0000>0,05). Therefore, null hypothesis is rejected (BOND has no unit root) and it means that BOND is stationary. Moreover, when prob(F-statistic) is observed, the result is signicifant since value less than 0,05 (p<0,05).

HETEROSCEDASTICITY (WHITE TEST)

Both of two variables were checked for heteroscedasticity by using white test. The results are shown below.

TABLE 5: HETEROSCEDASTICITY (WHITE TEST)

Heteroskedasticity Test: White

F-statistic	2.113553	Prob. F(2,345)	0.1224
Obs*R-squared	4.212253	Prob. Chi-Square(2)	0.1217
Scaled explained SS	11.38404	Prob. Chi-Square(2)	0.0034

F-statistic	2.651105	Prob. F(2,345)	0.0720
Obs*R-squared	5.267364	Prob. Chi-Square(2)	0.0718
Scaled explained SS	13.16059	Prob. Chi-Square(2)	0.0014

In the first column, p-value is less than 0,05 (0,0034) and another p-value is also less than 0,05 (0,0014). Results indicate that S&P500 and BOND yield are homoscedastic. For this reason, null hypothesis is rejected.

Regression Results

As can be seen, the first differenced data are stationary. Therefore, regression could be run on first differenced data in order to see the interaction between two variables. In regression equation, DLSP500 is depended, DLBOND is independed variable. Least squares method is selected for running regression. All results for regression are shown below.

TABLE 6: REGRESSION RESULT

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006982	0.002399	2.910717	0.0038
DLBOND	0.075658	0.036331	2.082448	0.0380

R-squared	0.012378	Mean dependent var	0.006684
Adjusted R-squared	0.009524	S.D. dependent var	0.044880
S.E. of regression	0.044666	Akaike info criterion	-3.373482
Sum squared resid	0.690285	Schwarz criterion	-3.351343
Log likelihood	588.9859	Hannan-Quinn criter.	-3.364668
F-statistic	4.336591	Durbin-Watson stat	1.888119
Prob(F-statistic)	0.038036		

As it is seen regression model is significant since p<0,05. That is independed variable (DLBOND) equals 0,0380 and prob(F-statistic) equals 0,038036. The regression results indicates that bond returns can explain 0.012 of sp500 returns (as R-square shows) and also Durbin-Watson statistic is close to 2, thus no autocorrelation in the model.

In regression equation, DLBOND is depended, DLSP500 is independent variable. Least squares method is selected for running regression. All results for regression are shown below.

TABLE 7: REGRESSION RESULT

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.005029	0.003560	-1.412587	0.1587
DLSP500	0.163609	0.078566	2.082448	0.0380
R-squared	0.012378	Mean dependent var	-0.003935	
Adjusted R-squared	0.009524	S.D. dependent var	0.065998	
S.E. of regression	0.065683	Akaike info criterion	-2.602226	
Sum squared resid	1.492728	Schwarz criterion	-2.580087	
Log likelihood	454.7873	Hannan-Quinn criter.	-2.593412	
F-statistic	4.336591	Durbin-Watson stat	1.871464	
Prob(F-statistic)	0.038036			

Regression model is significant since p<0,05. That is, independent variable (DLSP500) equals 0,0380 and prob(F-statistic) equals 0,038036. The regression results indicates that S&P500 returns can explain 0.012 of BOND returns (as R-square shows) and also Durbin-Watson statistic is close to 2, thus no autocorrelation in the model.

GRANGER CAUSALITY TEST

In this title, Granger Causality Test will be examined for BOND and S&P500. Results of test is shown below.

TABLE 8: GRANGER CAUSALITY TEST

Null Hypothesis:	Obs	F-Statistic	Prob.
DLBOND does not Granger Cause DLSP500	346	0.08159	0.9217
DLSP500 does not Granger Cause DLBOND		8.82004	0.0002

The results show that while bond returns do not Granger cause to SP500 returns, SP500 returns do Granger cause to bond returns. For this reason, past returns of SP500 can be used to forecast the one day ahead of bond returns.

4. CONCLUSION

Both of the investors who are risk takers and avoid the risks desire to make profit on financial markets. In order to estimate where trend will go, they follow numerous ways such as use of historical data, economic and financial news and use of mathematical equation by trying to turn these ways into opportunity. For this reason, relation among financial markets is essential topic for financial forecast.

In literature, there are many findigs abot relation between stock market and macroeconomic indicators. However, goal of this study is to examine interaction between stock and bond returns in U.S. for this reason, existence of causality relation between S&P500 yield and 10-years tresury bonds yield is tested via applying Granger Causality Test on stock and bond market data from 1985 to 2011.The conclusion reached by this study is ‘‘Past returns of SP500 can be used to forecast the next day returns of bond returns.’’ That is, while 10-Years Tresury Bonds retuns do not Granger cause to S&P500, S&P500 returns do Granger cause to bond returns.

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