Testing for seasonal anomalies in the Romanian Stock Market

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This paper investigates seasonal anomalies in stock returns on Bucharest Stock Exchange. The anomalies studied are two of the most common security price anomalies detected on international stock markets, the day-of-the-week effect and the month-of-the-year effect. The empirical research is conducted using daily logarithmic returns of the Romanian composite index, BET-C, over a six years period (January 2000- December 2005). A regression model using dummy variables is run to test the presence of these seasonal effects, but the results provide no support for the existence of these calendar effects on the Romanian stock market.

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JEL Classifications: *G10, G14*

For many years, financial analysts have been concerned about seasonality in stock returns.

The most important calendar effects studied are the day-of-the-week effect (significantly different returns on some day of the week; usually higher Friday returns and lower Monday returns), the monthly or January effect (relatively higher January returns), the trading month effect (returns higher over the first fortnight of the month) and the holiday effect (returns higher on the days before holydays). These market anomalies, if detected, are proofs of market inefficiencies.

This paper is concerned with two of the most common anomalies found on different stock markets of the world, and tries to test the presence of the two most common calendar effects, day-of-the-week effect and January effect, on Bucharest Stock Exchange.

Since Fama (1965), a vast number of papers have been concerned with these stock price anomalies, known as calendar effects. For a survey of common security price anomalies see Thaler (1987).

In what the day of the week effect is concerned, French (1980), Gibson and Hess (1981), Lakonishok and Levi (1982), Rogalski (1984), Kato (1990), Keim and Stambaugh (1984) demonstrate the presence of this phenomenon on different markets. It is however observed that most of these seasonal anomalies tend to disappear, or at least to lose significantly in magnitude over time.

1) Testing for Day-of-the-Week Effect on Bucharest Stock Exchange

One of the most common seasonal anomalies is the day-of-the-week effect. This analysis is based on the hypothesis that the yields produced by each security are not independent of the day of the week.

Daily observations of the Bucharest Stock Exchange Composite Index (BET-C) are employed to investigate the day of the week effect in the Romanian stock market. We consider a six years period (2000-2005), or a total of 1447 daily observations, which will be further divided into two sub samples with an approximately equal number of observations, in order to find any possible change, or if in fact there was one. In this way, the first sub sample would have 730 daily observations, covering the period January 6th till December 19th 2002 (last trading day in 2002) and the second sample would contain the remaining 717 observations, or the period January 6th 2003 (first trading day of the year)- December 23th 2005.

The following regression model is run, first for the whole period, and then for the two equal sub periods, in order to test whether there is any statistically significant difference among index returns on different days of the week:

Rt = B0 + B1D1t + B2D2t + B3D3t + B4D4t + ut

Where:

Rt: is the daily logarithmic return of BET-C index

Djt: are dummy variables which take on the value 1 if the corresponding return for day t is a Monday, Tuesday, Wednesday or Thursday and 0 otherwise.

Bi: Each of the estimated OLS coefficients for the dummy variables shows the estimated difference between returns in that day and returns on Friday.

The intercept, b_o in our equation, measures the average log return of the index for Friday.

ut: is the error term.

The hypothesis to be tested is:

H0: B1 = B2 = B3 = B4 = 0

TABLE 1: Statistics for daily regression-all six years (2000 -2005)

Regression Statistics	
Multiple R	0,01510575
R Square	0,000228184
Adjusted R Square	-0,002545108
Standard Error	1,349271304
Observations	1447

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,599166	0,149791619	0,082279	0,987845
Residual	1442	2625,209	1,820533051		
Total	1446	2625,808			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,149684561	0,079784	1,876120548	0,060841	-0,00682	0,30619
X Variable 1	-0,034814827	0,11313	-0,307740788	0,758324	-0,25673	0,187103
X Variable 2	0,009390239	0,112539	0,083440205	0,933513	-0,21137	0,230147
X Variable 3	0,02295698	0,112251	0,204515387	0,83798	-0,19724	0,243149
X Variable 4	-0,018433132	0,111782	-0,164902337	0,869044	-0,23771	0,20084

We can see that our equation estimates that the average return on Friday is 0,15 percent. As mentioned before, each of the estimated coefficients for the dummy variables shows the estimated difference between returns in that day and Friday returns. For example, if we look at Table 1, we find that the estimated return for Monday is 0,03 percent lower than Friday, which gives us a Monday prediction of about 0,12 percent. Mondays and Thursday are actually the only two days with estimated predictions lower than Friday.

Looking at the regression coefficients we notice a very low value for R-squared, which may suggest that a day-of-the-week effect in BET-C return may not be very important in explaining the evolution of the index.

We can use the F-statistics to analyze the null hypothesis that daily dummy variables are all equal to 0.

We are testing for significant daily variation of the Romanian index. From the ANOVA table, we find that, for 4 degrees of freedom, the F-statistic to determine whether all the regression slope coefficients are jointly equal to 0 is 0,08. We must next look in a table with critical values for F-test. If we choose a significance level of 0,05, we see that for 4 degrees of freedom of the numerator, the critical value is 2,37 when the denominator has an infinity of degrees of freedom. In our case (1442 degrees of freedom), the critical value would have to be larger than 2,37. The value for F-statistic is 0,08, so we clearly cannot reject the null hypothesis that all the coefficients jointly are equal to 0, which in fact means that we have no day-of-the-week effect on BSE..

The p-value of 0,95 shown for the F-test in Table 3 means that the smallest level of significance at which we can reject the null hypothesis is 0,98, or 98% , which is way above the conventional level of 5 percent.

Among the 4 dummy variables, we find for each of them very large p-values, which means that we have no statistically significant t-statistics, so we cannot reject the null hypothesis that the returns are equal across the days based on the t-test.

The situation does not change when the daily observations are divided in two equal sub samples, both covering a period of three years (See Table 2 and Table 3). For both sub periods, the regression coefficients are not statistically significant; in neither case the null hypothesis cannot be rejected. So, we can state that there is no day-of-the-week effect on BSE composite index.

TABLE 2: Statistics for daily regression - first three years (2000-2002)

Regression Statistics	
Multiple R	0,026465
R Square	0,0007
Adjusted R Square	-0,00481
Standard Error	1,436709
Observations	730

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1,04891	0,262227	0,12704	0,97265
Residual	725	1496,497	2,064134		
Total	729	1497,546			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,140275	0,119312	1,175696	0,240102	-0,09396	0,374513
X Variable 1	0,005648	0,169925	0,033239	0,973493	-0,32796	0,339253
X Variable 2	-0,05005	0,168444	-0,29716	0,766432	-0,38075	0,280641
X Variable 3	0,008627	0,168158	0,051306	0,959096	-0,32151	0,338762
X Variable 4	-0,08633	0,167048	-0,5168	0,605456	-0,41429	0,241626

TABLE 3: Statistics for daily regression- last three years (2003-2005)

Regression Statistics	
Multiple R	0,040957
R Square	0,001677
Adjusted R Square	-0,00393
Standard Error	1,25701
Observations	717

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1,89032	0,47258	0,299087	0,878589
Residual	712	1125,013	1,580075		
Total	716	1126,903			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95,0%*
Intercept	0,159361	0,105859	1,505405	0,132664	-0,04847	0,367195
X Variable 1	-0,07533	0,149444	-0,50404	0,614387	-0,36873	0,218077
X Variable 2	0,070012	0,149183	0,469303	0,638997	-0,22288	0,362904
X Variable 3	0,037347	0,148672	0,251204	0,801729	-0,25454	0,329234
X Variable 4	0,051844	0,14842	0,349308	0,726962	-0,23955	0,343238

2) Month-of-the Year Effect on Bucharest Stock Exchange

As stated before, we employ daily log returns of the BET-C index covering a six years period, from January 2000 through the end of 2005. We estimate next a regression equation including an intercept and 11 dummy variables, one for each of the first eleven months of the year. The equation that we estimate is:

$$Return_t = b_0 + b_1Jan_t + b_2Feb_t + \ldots\ldots + b_{11}Nov_t + u_t$$

Where each month dummy variable has a value of 1 when the month occurs and a value of 0 for the other months. The intercept, b_o in our equation, measures the average log return of the index for December. Table 4 shows the results of the above regression.

The regression equation estimates that the average return in December is 3,19 percent. Like before, each of the estimated coefficients for the dummy variables shows the estimated difference between returns in that month and returns in December. For example, if we look at Table 4, we find that the estimated return for January is 7,95 percent higher than December, which gives us a January prediction of 11,14 percent. This is actually the highest value we find between all 11 variables, followed by variable 2 (February) and variable 6 (June), the only three months with estimated prediction above that of December.

If we look further at the regression coefficients we find, however, a low R-squared, which may suggest that a month-of-the-year effect in BET-C return may not be very important in explaining the evolution of the index.

We can use the F-statistics to analyze the null hypothesis that monthly dummy variables are all equal to 0.

$$H_0: b_1 = b_2 = b_3 = \ldots\ldots = b_{11} = 0$$

TABLE 4: Statistics for monthly regression (2000-2005)
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,417216
R Square	0,174069
Adjusted R Square	0,020082
Standard Error	7,985898
Observations	71

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	793,0075	72,09159	1,130413	0,355018
Residual	59	3762,7	63,77457		

Total	70	4555,707

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	3,196884	3,260229	0,98057	0,330809	-3,32683	9,720595
X Variable 1	7,954564	4,835702	1,644966	0,105295	-1,72166	17,63079
X Variable 2	0,524058	4,610661	0,113662	0,909891	-8,70186	9,749978
X Variable 3	-8,85561	4,610661	-1,92068	0,059609	-18,0815	0,370306
X Variable 4	-0,14709	4,610661	-0,0319	0,974657	-9,37301	9,078828
X Variable 5	-0,70607	4,610661	-0,15314	0,878811	-9,93199	8,519848
X Variable 6	0,201338	4,610661	0,043668	0,965317	-9,02458	9,427259
X Variable 7	-0,85541	4,610661	-0,18553	0,85345	-10,0813	8,370507
X Variable 8	-1,15225	4,610661	-0,24991	0,803526	-10,3782	8,073675
X Variable 9	-0,14757	4,610661	-0,03201	0,974575	-9,37349	9,078348
X Variable 10	-0,2432	4,610661	-0,05275	0,958111	-9,46912	8,98272
X Variable 11	-0,81037	4,610661	-0,17576	0,861084	-10,0363	8,415546

We are testing for significant monthly variation of the Romanian composite index. Looking at the ANOVA table, we find that, for 11 degrees of freedom, the F-statistic to determine whether all the regression slope coefficients are jointly equal to 0 is 1,13. We must next look in a table with critical values for F-test. If we choose a significance level of 0, 5, we see that for 11 degrees of freedom of the numerator, the critical value is 1,95 when the denominator has 60. In our case (59 degrees of freedom), the critical value would have to be larger than 1,95. The value for F-statistic is 1,13, so we clearly cannot reject the null hypothesis that all the coefficients jointly are equal to 0.

The p-value of 0,35 shown for the F-test in Table 3 means that the smallest level of significance at which we can reject the null hypothesis is 0,35, or 35% - above the conventional level of 5 percent.

Among the 11 dummy variables, we find no statistically significant value for t-statistic, so we cannot reject the null hypothesis that the returns are equal across the months based on the t-test. The only coefficient with a p-value close to the accepted level of 0,05 is variable 3, which represents the estimated return from March. In our case, this value is by far the smallest one found among all monthly coefficients (8,85 % smaller than the estimated return for December).

In conclusion, the higher return observed in January is not statistically significant, (nor are the other regression coefficients), which means the null hypothesis cannot be rejected and we do not encounter a month-of-the-year effect on Bucharest Stock Exchange.

As we saw earlier, we could not prove the presence of a day-of-the-week effect on BET-C index either. The results are quite surprising, as we expected to find some anomalies which could prove that Bucharest Stock Exchange is not an efficient market. Nevertheless, further investigation must be conducted and other seasonal anomalies tested before we could reject the hypothesis that calendar anomalies are present on BSE.

References:

Campbell, John Y. and Lo, Andrew W. and MacKinlay, A. Craig , *The Econometrics of Financial Markets*, Princeton University Press

Dimitris Kenourgios, Aristeidis Samitas and Spyros Papathanasiou, *The Day of the Week Effect Patterns on Stock Market Return and Volatility: Evidence for the Athens Stock Exchange*, http://econpapers.repec.org/paper/wpawuwpfi/0512028.htm

Fama, E.F., *The behavior of stock market prices*, Journal of Business, 34, 31-105, 1965.

French, K.R., *Stock returns and the weekend effect*, Journal of Financial Economics, 8, 55-69, 1980.

Gibbons, M.R. and Hess, P.J., *Day of the week effects and asset returns*, Journal of Business, 54, 579-96, 1981.

Jaffe, J. and Westerfield, R., *Patterns in Japanese Common Stock Returns: Day of the Week and Turn of the Year Effects*, Journal of Financial and Quantitative Analysis, 261- 272, 1985.

Jaffe, J.R. and Westerfield, R., *The weekend effect in common stock returns: the international evidence*, Journal of Finance, 40, 432-54, 1985.

Kato, Kiyoshi, *Weekly patterns in Japanese stock returns*, Management Science, Vol 36, No 9, September 1990, pp 1031-1043

Keim, D.B., and Stambaugh, F., *A further investigation of weekend effects in stock returns*, Journal of Finance, 39, 819-40, 1984.

Mehmet F. Dicle and M. Kabir Hassan, *Day of the Week Effect in Istanbul Stock Exchange*, Scientific Journal of Administrative Development, Vol. 5, 2007

Syed A. Basher and Perry Sadorsky, *Day-of-the-week effects in emerging stock markets*, Applied Economics Letters, Volume 13, Number 10 / 15 August 2006

Thaler, Richard, *Anomalies: Seasonal Movements in Security Prices: Weekend, Holiday, Turn of the Month, and Intraday Effects*, The Journal of Economic Perspectives, Vol 1, No 2, 1987, 169-177

Tsay, Ruey; *Analysis of Financial Time Series*, John Wiley & Sons, Inc., 2002.