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TOQ Effects on the Romanian Foreign Exchange Market

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Many calendar anomalies were identified not only on the capital markets but also on the foreign exchange markets. This paper explores the Turn-of-the-quarter (TOQ) Effect presence on the Romanian Foreign Exchange Market. We employ daily values of the official exchange rates of the Romanian national currency against euro and US dollar for two periods: January 2007 - December 2014 and January 2015 - April 2021. The results of the investigation revealed significant changes that occurred in TOQ Effects from the first to the second period.

Keywords: TOQ Effect, Changes in time intervals of the calendar anomalies, Romanian Foreign Exchange Market

JEL: F31, G14, G40

1. Introduction

The calendar anomalies were studied mainly in relation with the stock markets. There are also some investigations about the presence of various forms of seasonality on the foreign exchange market (Aydoğan & Booth, 2003; Yamori & Kurihara, 2004; Berument et al., 2007; Kumar & Pathak, 2016). For a good understanding of the calendar anomalies associated to foreign exchange rates it is necessary the knowledge about the similarities and differences between foreign currency markets and stock markets. As in the case of stock markets, on many foreign exchange markets the speculative transactions play often a major role (Frankel & Froot, 1986; Taylor, 1995; Vitale, 2000; Westerhoff, 2001). The currency speculation could generate various patterns, including several forms of seasonality.

Some essential particularities of the calendar anomalies from foreign exchange markets could be linked to the central banks' interventions. Many of the important characteristics of such interventions are induced by the type of foreign exchange rates regime applied: hard or soft peg, floating regimes etc. (Ghosh et al., 2002; Klein & Shambaugh, 2008; Jeanne & Rose, 2002; Rose, 2011).

In this paper we approach the presence of a calendar anomaly, Turn-of-the-quarter (TOQ) Effect, on Romanian foreign exchange market. TOQ Effect consists in abnormal returns occurring in the first and in the last trading days of the quarters. This form of seasonality was detected on Bucharest Stock Exchange for two periods: January 2007 – December 2013 and January 2014 – July 2020 (Stefanescu & Dumitriu, 2020). There were also found significant linkages between the Romanian capital and foreign exchange markets (Stefanescu & Dumitriu, 2013). Some circumstances that are considered as possible responsible for the presence of TOQ Effects on stock markets, such as the reactions to the macroeconomic news or stock markets' liquidity, could also generate this calendar anomaly on the foreign exchange markets (Thaler, 1987; Booth et al., 2001; Baker & Stein, 2004; Nikkinen

et al., 2006; Gerlach, 2007). The intervention of the central bank (NBR – National Bank of Romania) on Romanian foreign exchange market is quite consistent although the targets on the exchange rates are not publicly announced. In the last years there were suspicions in the public opinion from Romania that in some time intervals, which include days from TOQ, NBR depreciated the national currency in order to increase the amount of some indirect taxes which had the basis calculated in foreign currencies.

In this investigation we use daily values of the official exchange rates for the Romanian leu (RON), the Romanian national currency, in terms of euro (EUR) and United States dollar (USD). In order to reveal the changes experienced in time by the TOQ Effect, we perform our analysis for two periods:

- the first one, from January 2007 to December 2014;
- the second one, from January 2015 to April 2021.

The reminder of this paper is organized as it follows: the second part describes the data and the methodology used to identify TOQ Effects on the returns of exchange rates, the third part presents the empirical results and the fourth part concludes.

2. Data and Methodology

2.1. Description of the Data

We study the presence of TOQ Effect on Romanian foreign exchange market by employing the daily closing values of official exchange rates, provided by NBR, for the Romanian leu against two foreign currencies: euro and United States dollar (Figure 1). The sample of data was split into two sub-samples:

- the first sub-sample, from January 2007 to December 2014;
- the second sub-sample, from January 2015 to April 2021.

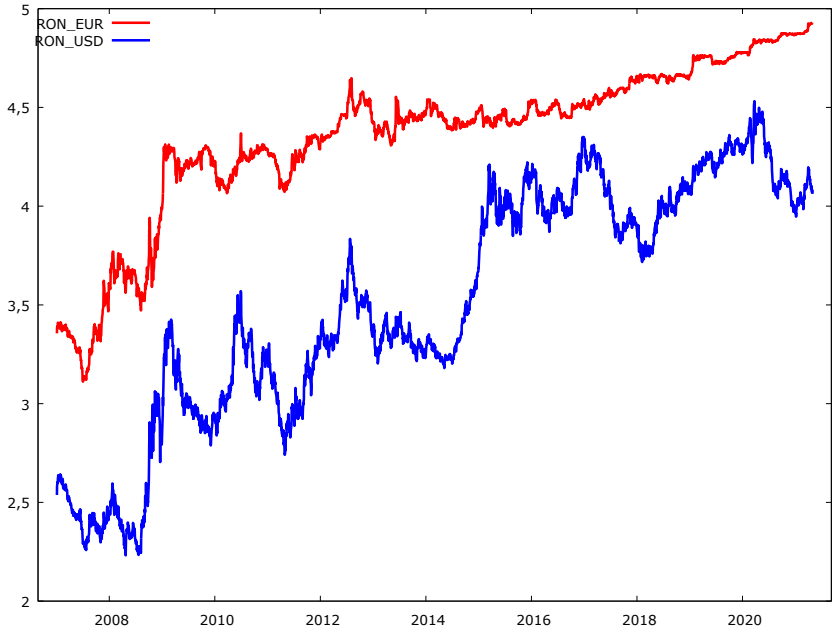

Figure 1. Evolution of the daily official exchange rates for the Romanian leu against euro (RON_EUR) and United States dollar (RON_USD) from January 2007 April 2021

Source of the daily values: https://www.bnr.ro

For each exchange rate, we compute the logarithmic returns ($r_{i,t}$) using the formula:

$$r_{j,t} = [\ln(NEER_{j,t}) - \ln(NEER_{j,t-1})] \times 100 \quad (1)$$

in which $NEER_{j,t}$ and $NEER_{j,t-1}$ are the closing values of official exchange rate j on the days t and t-1, respectively.

We use the notations:

- r_RON_EUR for the returns of official exchange rates for the Romanian leu against euro;
- r_RON_USD for the returns of the official exchange rates for the Romanian leu against United States dollar.

Table 1. Descriptive statistics of the returns for the two sub-samples

Variable	Mean	Median	S.D.	Min	Max	Jarque-Bera test
First sub-sample						
r_RON_EUR	0.0142	-0.0070	0.392	-2.54	2.93	4977.96***
r_RON_USD	0.0184	-0.0271	0.810	-4.81	4.43	1211.25***
Second sub-sample						
r_RON_EUR	0.0059	0.0022	0.140	-0.76	0.90	2136.28***
r_RON_USD	0.0061	0.0001	0.534	-2.53	3.20	576.114***

Note: **** means significant at 0.01 levels.*

The Table 1 reports the descriptive statistics of returns for the two sub-samples. For both exchange rates the average values experienced significant declines from the first to the second period. Also for both exchange rates the volatility was much higher in the first sub-sample than in the second. The results of Jarque-Bera tests suggest that returns didn't follow normal distributions.

We search for the abnormal returns in a TOQ interval that includes the last five trading days (BQ-k, $1 \le m \le 5$) of a quarter and the first five trading days of next quarter (BQ+k, $1 \le n \le 5$).

$$\begin{pmatrix} BQ-5;\ BQ-4;\ BQ-3;\ BQ-2;\ BQ-1; \\ BQ+1;\ BQ+2;\ BQ+3;\ BQ+4;\ BQ+5 \end{pmatrix}$$

The averages of returns for these ten trading days are presented in the Table 2. For the first sub-sample, the lowest returns occurred, for both exchange rates, in BQ-5, while the highest returns could be found in BQ-1, in the case of r_RON_EUR, and BQ-2, in the case of r_RON_USD. For the second sub-sample we found the lowest returns in BQ+1, for r_RON_EUR, and BQ+3, for r_RON_USD, while the highest occurred in BQ-3, in the case of r_RON_EUR and BQ+1 in the case of r_RON_USD.

Table 2. Average returns of the exchange rates for the trading days of [BQ-5; BQ+5] time interval

Trading day	First sub-sample		Second sub-sample	
	r_RON_EUR	r_RON_USD	r_RON_EUR	r_RON_USD
BQ-5	−0.152529	−0.221946	0.0222096	0.101450
BQ-4	0.0134717	0.0601699	−0.0340553	−0.00263837
BQ-3	−0.0433539	−0.196511	0.0468199	0.0896892

Trading day	First sub-sample		Second sub-sample	
	r_RON_EUR	r_RON_USD	r_RON_EUR	r_RON_USD
BQ-2	0.115877	0.352900	0.0329463	−0.0225190
BQ-1	0.148196	−0.152507	0.0241904	0.0533760
BQ+1	−0.0202378	0.182629	−0.0708836	0.165120
BQ+2	0.0356662	0.208622	0.0234421	0.0639039
BQ+3	−0.00314803	0.0263765	0.0124921	−0.0587214
BQ+4	0.0515695	0.210038	−0.00344131	−0.00547461
BQ+5	0.120197	0.182721	0.0296440	0.103292
Rest of the trading days	0.0119225	0.0097341	0.0054954	−0.002067

We try to identify the abnormal returns of exchange rates from the TOQ interval using regressions with two categories of dummy variables, associated with the trading days from the end (BQ-k) and from the beginning of a quarter (BQ+k). For BQ-k trading days we employ the dummy variables:

$$DBQ_{-k,t} = \begin{cases} 1, \ if\ the\ day\ t\ is\ the\ k^{th}\ last\ trading\ day\ of\ a\ quarter \\ 0, \ otherwise \end{cases}$$

where 1≤k≤5.

In the case of BQ+k trading days we use the dummy variables:

$$DBQ_{+k,t} = \begin{cases} 1, \ if\ the\ day\ t\ is\ the\ k^{th}\ trading\ day\ of\ a\ quarter \\ 0, \ otherwise \end{cases}$$

where 1≤k≤5.

2.2. Methodology

In order to detect the abnormal returns occurring in the TOQ intervals we use the classical GARCH (1,1) model of Engle (1982) and Bollerslev (1986). This model consists in two equations:

a. the conditional mean equation;

b. the conditional variation equation.

a. The **conditional mean equation** has the form:

$$r_{j,t} = \mu_0 + \sum_{k=1}^{5} \lambda_k \times DBQ_{-k,t} + \sum_{k=1}^{5} \rho_k \times DBQ_{+k,t} + \sum_{i=1}^{q} \xi_i \times r_{j,t-i} + \varepsilon_t \qquad (2)$$

where:

- μ_0 denotes a constant term;
- λ_k is a coefficient associated to the dummy variable $DBQ_{-k,t}$ which allows capturing the influence on returns of the last k^{th} trading day of a quarter;
- ρ_k is a coefficient associated to the dummy variable $DBQ_{+k,t}$ which allows capturing the influence on returns of the k^{th} trading day from the beginning of a quarter;
- ξ_i represents a coefficient of i-order lagged returns of the dependent variable;
- q is the number of lagged returns;
- ε_t represents the error term that follows a normal distribution with zero mean and a time varying variance h_t:

$$\varepsilon_t \mid I_{t-1} \sim N(0, h_t)$$

We identify the abnormal returns of exchanges rates associated to BQ-m or BQ+n trading days using the values of λ_i and ϱ_i coefficients. A significant positive value means abnormal high returns, while a significant negative value indicates abnormal low returns.

b. The **conditional variation equation** consists in:

$$h_t = \omega + \alpha_1 \times \varepsilon_{t-1}^2 + \beta_1 \times h_{t-1} \quad (3)$$

where:

- ω represents a constant term;
- α_1 is a coefficient associated to the lagged squared residuals;
- β_1 represents a coefficient associated to the lagged variance.

Before performing GARCH regressions we have to study if the returns of exchange rates are stationary. For such purpose we employ the well-known Augmented Dickey – Fuller (ADF) unit root tests (Dickey & Fuller, 1979; Dickey & Fuller, 1981). Based on the graphical representation we chose using two variants of this test: with and without constant (Figure 2).

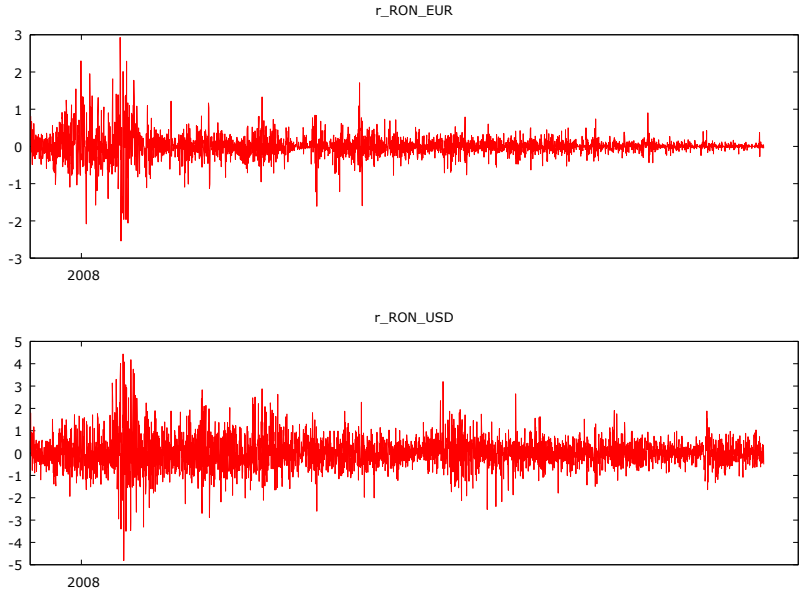

Figure 2. Evolution of the daily returns for official exchange rates of Romanian leu against euro (r_RON_EUR) and United States dollar (r_RON_USD) from January 2007 April 2021

Source of the daily values: https://www.bnr.ro

3. Empirical Results

The results of ADF tests indicate that for both exchange rates and for both sub-samples the returns were stationary (Table 3).

Table 3. Results of ADF tests

Index	Test without constant		Test with constant	
	Number of lags	Test statistic	Number of lags	Test statistic
First sub-sample				
r_RON_EUR	6	-16.2375***	6	-16.3026***
r_RON_USD	12	-12.4192***	12	-12.4552***

Index	Test without constant		Test with constant	
	Number of lags	Test statistic	Number of lags	Test statistic
Second sub-sample				
r_RON_EUR	17	-10.1674***	17	-10.3687***
r_RON_USD	5	-17.7912***	5	-17,8754***

Notes: Akaike (1974) Information Criterion was used to identify the optimum number of lags;
**** means significant at 0.01 levels.*

The results of GARCH regressions for both sub-samples are presented in the Table 4. In the case of r_RON_EUR we found, for the first sub-sample, a significant negative value of λ_5 and a significant positive value of ϱ_5. For the second sub-sample we obtained a significant positive value of λ_2 and a significant negative value of ϱ_1. In the case of r_RON_USD the results indicate, for the first sub-sample, a significant positive value of λ_2 and a significant negative value of ϱ_1. For the second sub-sample we found no significant coefficient of the dummy variables associated to TOQ Effect.

Table 4. Coefficients of GARCH equations

Coefficient	First sub-sample		Second sub-sample	
	r_RON_EUR	r_RON_USD	r_RON_EUR	r_RON_USD
μ_0	0.00491316 (0.00571952)	0.00662680 (0.0153940)	0.00395759 (0.00251600)	−0.00278079 (0.0129020)
λ_5	−0.103755** (0.0453227)	−0.186508 (0.113783)	0.0105643 (0.0183741)	0.0752681 (0.0945393)
λ_4	0.0323105 (0.0455512)	0.0419969 (0.112794)	−0.00420788 (0.0228693)	0.0126741 (0.0952800)
λ_3	−0.0597427 (0.0417166)	−0.177827 (0.113783)	0.0172076 (0.0191930)	0.0790617 (0.0938005)
λ_2	0.0741843 (0.0465357)	0.248903** (0.113025)	0.0523199*** (0.0199228)	−0.0200331 (0.0945510)
λ_1	0.0442767 (0.0423467)	−0.194446* (0.113082)	0.00151730 (0.0228122)	0.0808140 (0.0950894)
ϱ_1	−0.0524441 (0.0484717)	0.0154518 (0.115010)	−0.0611962*** (0.0189053)	0.149455 (0.0925742)
ϱ_2	0.0251442 (0.0482140)	0.157572 (0.113784)	−0.00378962 (0.0189140)	0.0408927 (0.0936515)
ϱ_3	−0.0399642 (0.0456964)	0.0712482 (0.114214)	0.00179302 (0.0198698)	−0.0738458 (0.0944205)
ϱ_4	−0.0195198 (0.0472006)	0.135780 (0.112757)	−0.0139539 (0.0190628)	0.00148735 (0.0937949)
ϱ_5	0.108544** (0.0443770)	0.0643704 (0.113356)	0.00988605 (0.0185192)	0.0783324 (0.0937853)
ξ_1	0.121869*** (0.0247792)	x	x	x
ω	0.001811*** (0.0004189)	0.00272149** (0.00115549)	0.000421573*** (0.000117228)	0.00110478* (0.000605333)
α_1	0.148820***	0.0466839***	0.170136***	0.0261305***

Coefficient	First sub-sample		Second sub-sample	
	r_RON_EUR	r_RON_USD	r_RON_EUR	r_RON_USD
	(0.0216988)	(0.00642983)	(0.0386393)	(0.00556913)
β_1	0.847832***	0.949252***	0.754435***	0.969369***
	(0.0192236)	(0.00679547)	(0.115795)	(0.00632829)

Notes: *Standard errors are within parentheses; ***, ** and * mean significant at 0.01, 0.05 and 0.1 levels, respectively.*

4. Conclusions

The results of this investigation revealed significant changes in TOQ Effects occurring from the first (January 2007 - December 2014) to the second (January 2015 - April 2021) period of time. In the case of r_RON_EUR, this calendar anomaly that consisted, for the first sub-sample, in abnormal low returns in BQ-5 and in abnormal high returns in BQ+5 passed, in the second sub-sample, to another form, characterized by abnormal high returns in BQ-2 and abnormal low returns in BQ+1. For r_RON_USD, TOQ Effect materialized, in the first sub-sample, in abnormal high returns in BQ-2 and abnormal low returns in BQ-1, disappeared for the second sub-sample. Both periods of time were affected by significant turbulences that had different causes. During the period from January 2007 to December 2014 the financial markets were affected by the Great Recession (including the episodes of the global financial crisis and the European sovereign debt crisis), while in the period from January 2015 to April 2021 occurred China – United States trade war and the coronavirus pandemic.

This investigation could be extended to the changes experienced by other calendar anomalies associated to the Romanian foreign exchange market.

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