Bankacılık ve Finansal Araştırmalar Dergisi, 2020; 7(2): 81-92
Journal of Banking and Financial Research 2020; 7(2): 81-92

Araştırma Makalesi / Research Article

Bermuda Triangle of Turkey: The Asymmetric Relationship Between FX Markets, Stock Markets and Credit Default Swaps

Caner ÖZDURAK[1] - Veysel ULUSOY[2]

Gönderim Tarihi	Kabul Tarihi
28.01.2020	03.03.2020

Önerilen Atıf / Suggested Citation:
Özdurak, C., & Ulusoy, V. (2020). Bermuda Triangle of Turkey: The Asymmetric Relationship between FX Markets, Stock Markets and Credit Default Swaps. *Bankacılık ve Finansal Araştırmalar Dergisi*, *7*(2), 81-92.

Abstract

In April 2019 Turkish authorities tried to avoid a currency qualm before March local elections by orchestrating a market in which investors can't move out of liras easily, In our study we focus on impact of credit default swap (CDS) and stock market impact to FX markets in order to analyze whether the FX rates in the market is a natural balance of the market dynamics or an outcome of an engineered rate of Central Bank of the Republic of Turkey) CBRT and Turkish government policies. We utilized Impulse-Response analysis, Granger Causality Tests and EGARCH models to conclude that USDTRY rates are managed by the policy makers to provide favorable CDS rates and stock market returns.

Keywords: *CDS, FX markets, BIST 100, Swaps, EGARCH Models, Volatility Modeling*

JEL Codes: *C58, G15, C53*

Türkiye'nin Bermuda Şeytan Üçgeni: Kredi Temerrüt Takası, Kur ve Hisse Senedi Piyasaları Arasındaki Asimetrik İlişki

Öz

Nisan 2019'da Türkiye'de karar vericiler Mart'ta yapılacak olan yerel seçimlerinden önce bir döviz kuru krizinden kaçınmak için yatırımcıların kolayca liraya karşı pozisyon almalarını engelleyebilmek adına piyasalarda düzenleyici uygulamalara başvurdu. Bu çalışmada Kredi Temerrüt Takası (KTT) ve hisse senedi piyasalarının kur üzerindeki etkilerini inceleyerek, piyasada oluşan kur seviyesinin doğal bir denge sonucu mu yoksa karar vericiler ve Merkez Bankası tarafından üretilen politikaların bir sonucu olarak mı oluştuğu araştırılmıştır. Etki-Tepki Analizleri, Granger Nedensellik Testleri ve Üssel Genelleştirilmiş Otoregresiv Koşullu Değişen Varyans (EGARCH) modellerini kullanarak dolar/TL kurunun politika yapıcılar tarafından uygun KTT oranları ve borsa getirileri sağlamak için baskılandığı sonucuna varılmıştır

Keywords: *KTT, Döviz Piyasaları, BIST 100, Swap, EGARCH Modelleri, Volatilite Modellemesi*

JEL Codes: *C58, G15, C53*

[1] Assistant Professor at Yeditepe University, Turkey. E-mail: caner.ozdurak@yeditepe.edu.tr. https://orcid.org/0000-0003-0793-7480
[2] Professor at Yeditepe University, Turkey. E-mail: veysel.ulusoy@yeditepe.edu.tr. https://orcid.org/0000-0001-7227-894X

1. Introduction

In 2019 extraordinary swap application of CBRT as a reaction to depreciation of Turkish Lira against US Dollar became a hot topic in financial markets. Turkish regulators orchestrated a currency crunch by curbing banks' capacity to lend to withhold liquidity to foreign investors who want to bet against the monetary unit. This forced investors who wanted to get out of their lira positions to instead sell other Turkish assets to get the cash they needed to close their positions. Fund managers including many international financial institutions said they were rethinking investments in the country. The exchange rate rally started on 21st of March 2019 while Turkey's 5-year credit default swaps hit 520 bp on 24th of May 2019, reaching the highest level on record since 2018. The all-time high 5-year CDS level posted for Turkey of 566 was registered on 4th of September 2018 just before the CBRT increased its main policy rate by 625bp in a belated response to the havoc of lira crisis. By engineering a market in which investors can't move out of liras easily, Turkish authorities avoided a currency qualm before March local elections that'd determine who governs Turkey's cities.

2. Literature Review

There is a wide range of literature study covering the default risk in the markets such as Black Scholes (1973), Merton (1974), Chen et all (1986), Longstaff and Schwartz (1995), Hamilton and Lin (1996), Duffie and Singleton (1999). In the recent studies about relationship between CDS and macroeconomic factors increased. Eyssell et all (2013) utilized a dataset between January 2001 and December 2010 concluding that China Sovereign Default Swaps have a negative and significant relationship with stock market indices. Moreover, according to the same article the relationship between CDS and real interest rates is positive and significant.

Naifar and Abid (2006) conclude that CDS and stock market volatility have a negative and significant relationship. Norden and Webber (2009) used VaR models to analyze the relationship between CDS, bonds and stock market concluding that CDS market is more sensitive to stock market compared to bond market. Longstaff et all (2011) state that locak stock market returns and FX rates have a significant impact on CDS. Impact of US stock market and US bond was higher than the other countries in their dataset while Blau and Roseman (2014) find a positive and significant relationship between FX rates and CDS rates.

As we see most of the studies in related literature focus on the impact of macroeconomic indicators like inflation, real interest rates, FX markets, foreign debt, budget deficit etc. on CDS rates. However, in our study we focus on impact of CDS rate and stock market impact on FX markets in order to analyze whether the FX rates in the market is a natural balance of the market dynamics or an outcome of an engineered rate of CBRT and Turkish government policies.

3. Database and Descriptive Statistics

The study considers daily closing prices for USD to TRY exchange rate (USDTRY), 5-year Turkey Credit Default Swaps (CDS) and Borsa İstanbul 100 Index (BIST 100). Data for all assets has been taken from Thompson Reuters Eikon. The dataset is arranged for two different time periods. First period is between 1st of January 2015 and 24th of May 2019 and second period is between 1st of March 2019 and 24th of May 2019 which is the beginning of "swap wars" period. If the opposite is not stated in the results all of the variables are used in logarithm form. Only returns are mentioned as "returns" in the models. In Granger causality tests and Impulse-Response analysis logarithm of the variables is used.

Table 1 illustrates the descriptive statistics of return of the series. As evident from Table 1, the returns of all series are negatively skewed and the kurtosis is much higher than 3 for all the cases. This is indicative of the deviation of series from the normal distribution which is also supported with Jarque-Bera statistics. Further the stationarity of the variables has been examined using Augemented Dickey-Fuller (ADF) unit root test. The null hypothesis of the unit root is rejected for all return series. Returns of all series are calculated by taking the first differences of the logarithm of the two successive prices i.e. $r_t = \log(P_t - P_{t-1})$ which are RUSDTRY, RBIST100 and R5YCDS. It is visible that industry indices second period experience more volatility clustering than the first period.

Table 1: *Descriptive Statistics of Return of the Series*

	First Period			Second Period		
	R5YCDS	RBIST100	RUSDTRY	R5YCDS	RBIST100	RUSDTRY
Mean	0.0008	0.0001	0.0008	0.0096	-0.0036	0.0022
Median	-0.0001	0.0006	0.0004	0.0074	-0.0027	0.0022
Maximum	0.2457	0.0526	0.1482	0.1225	0.0404	0.0536
Minimum	-0.1206	-0.0735	-0.0766	-0.0847	-0.0584	-0.0409
Std. Dev.	0.0279	0.0129	0.0113	0.0380	0.0149	0.0143
Skewness	1.0525	-0.4331	2.0508	0.5093	-0.4889	0.0268
Kurtosis	11.1853	5.1278	34.7455	4.6686	5.7868	7.7440
Jarque-Bera	3214.35	237.50	46107.12	8.92	20.35	52.52
Probability	0.0000	0.0000	0.0000	0.0116	0.0000	0.0000
ADF Tests (Level)	-29.523	-32.305	-22.241	-5.7257	-6.4521	-9.3293
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Betw een parenthesis: p-values. The number of observations for first period is 1080 and for second period 56
JB are the empirical statistics for Jarque Bera tests for normality based on skew ness and kurtosis
ADF Tests refer to Augemented Dickey Fuller test for the presence of unit root for long differences (returns)

4. Methodology

Initially we display the impulse-response results of certain shocks to financial markets. However, since impulse-response analysis is a good method to give a idea about the relationship of the variables it is not enough to give information about the causalities. In this context we also applied Granger causality tests for CDS, USDTRY and BIST 100 Index. Afterwards based on these short-term results we used exponential GARCH (EGARCH) instruments to model the volatility behavior of USDTRY based on 5Y Turkey CDS and BIST 100 Index and a new Index we used to decompose variance equation in to more detail.

The Index we generated is:

$$Index = \frac{ln(Bist\ 100\ Index)}{ln(5Y\ Turkey\ CDS)}$$

If we denote $Q(t)$ as the probability of default by time (t):

$$Q(t) = 1 - e^{-\int_0^t \lambda(T)tdt} \quad [4.1]$$

or

$$Q(t) = 1 - e^{-\lambda(t)t} \quad [4.2]$$

where $\lambda(t)$ is the average default intensity between time 0 and time *t* (Hull, 2002)

Based on the approximate calculation of credit spreads;

$$\lambda = \frac{S(T)}{1-R} \quad [4.3]$$

Where *S(T)* is the credit spread (expressed with continuous compounding) for maturity T, R is recovery rate and $\lambda(t)$ is again the average default intensity (average hazard rate) between time 0 and time *t*. If we rearrange [4.2] as the following:

$$Q(t) = 1 - e^{-\left(\frac{S(T)}{1-R}\right)t} \quad [4.4]$$

$$1 - Q(t) = e^{-\left(\frac{S(T)}{1-R}\right)t} \quad [4.5]$$

$$ln\left(1 - Q(t)\right) = -\left(\frac{S(T)}{1-R}\right)t \quad [4.6]$$

$$S(T) = ln\left(1 - Q(t)\right) \times \frac{(R-1)}{t} \quad [4.7]$$

We can conclude with the credit risk form that we use in our Index variable as:

$$ln\left(S(T)\right) = ln\left(ln\left(1 - Q(t)\right) \times \frac{(R-1)}{t}\right) \quad [4.8]$$

Hulls equation is a gross simplification. This equation is not perfect but is far more accurate and works for all tenor points. It generally works well except when approaching boundary conditions (distressed credits). The probability of a default for the related country (Turkish government in our case) is a minimization problem of $\frac{S(T)}{1-R}$ for a healthy financial market and obtaining a high credit rating. To minimize the probability of default either the recovery rate of the country should increase, or credit spread is expected to decrease.

Usually financial data suggests that some time periods are riskier than others. The goal of such models is to provide a volatility measure, like a standard deviation, which can be used in financial decisions related with risk analysis, portfolio selection and derivative pricing (Engle 1982, 1993 and 2001). Since Borsa Istanbul 100 Index is a good benchmark for the market return and 5Y Turkey CDS is a good benchmark of the financial market risk we generated index to reflect the marginal impact of investor decisions in the short-term. An important characteristic of asset prices is that "bad" news have a more persistent impact on volatility than "good" news have Most of the stocks has a strong negative correlation between the current return and the future volatility. In this context we can define leverage effect as such volatility tends to decrease when returns increase and to increase when returns decrease. The idea of the leverage effect is exhibited in the figure below, where "new information" is defined and measured by the size of ε_{t-1}. If $\varepsilon_{t-1}=0$, expected volatility (h_t) is 0. One problem with a standard GARCH model is that it is necessary to ensure that all of the estimate coefficients are positive. Nelson (1991) proposed a specification that does not require non-negativity constrains.

Consider:

$$\ln(h_t) = \alpha_0 + \alpha_1\left(\frac{\varepsilon_{t-1}}{h_{t-1}^{+0.5}}\right) + \lambda_1 \left| \frac{\varepsilon_{t-1}}{h_{t-1}^{0.5}} \right| + \beta_1 \ln(h_{t-1}) \quad [4.9]$$

Equation (4.9) is called the exponential-GARCH or EGARCH model. There are three interesting features to notice about EGARCH model:

1. The equation for the conditional variance is in log-linear form. Regardless of the magnitude of $\ln(h_t)$, the implied value of h_t can never be negative. Hence, it is permissible for the coefficients to be negative.
2. Instead of using the value of ε_{t-1}^2, the EGARCH model uses the level of standardized value of ε_{t-1}^2 [i.e., ε_{t-1}^2 divided by $(h_{t-1})^{0.5}$]. Nelson argues that this standardization allows for a more natural interpretation of the size and persistence of shocks. After all, the standardized value of ε_{t-1}^2 is a unit-free measure.
3. The EGARCH model allows the leverage effects. If $\varepsilon_{t-1}^2/(h_{t-1})^{0.5}$ is positive, the effect of the shock on the log of conditional variance is $\alpha_1 + \lambda_1$. If $\varepsilon_{t-1}^2/(h_{t-1})^{0.5}$ is negative, the effect of the shock on the log of the conditional variance is $-\alpha_1 + \lambda_1$.

The trade-off between future risks and asset returns are the essence of most financial decisions. Risk is mainly composed of two factors such as volatilities and correlations of financial assets. Since the economy changes frequently and new information is distributed in the markets second moments evolve over-time. Consequently, if methods are not carefully established to update estimates rapidly then volatilities and correlations measured using historical data may not be able to catch differentiation in risk (Cappiello et. all, 2006).

Finally, the model we incorporate for returns of USDTRY is:

$$R_{USDTRY} = \omega_0 + \beta_1 R_{BIST100} + \beta_2 R_{5YCDS} + \varepsilon_t \quad [4.10]$$

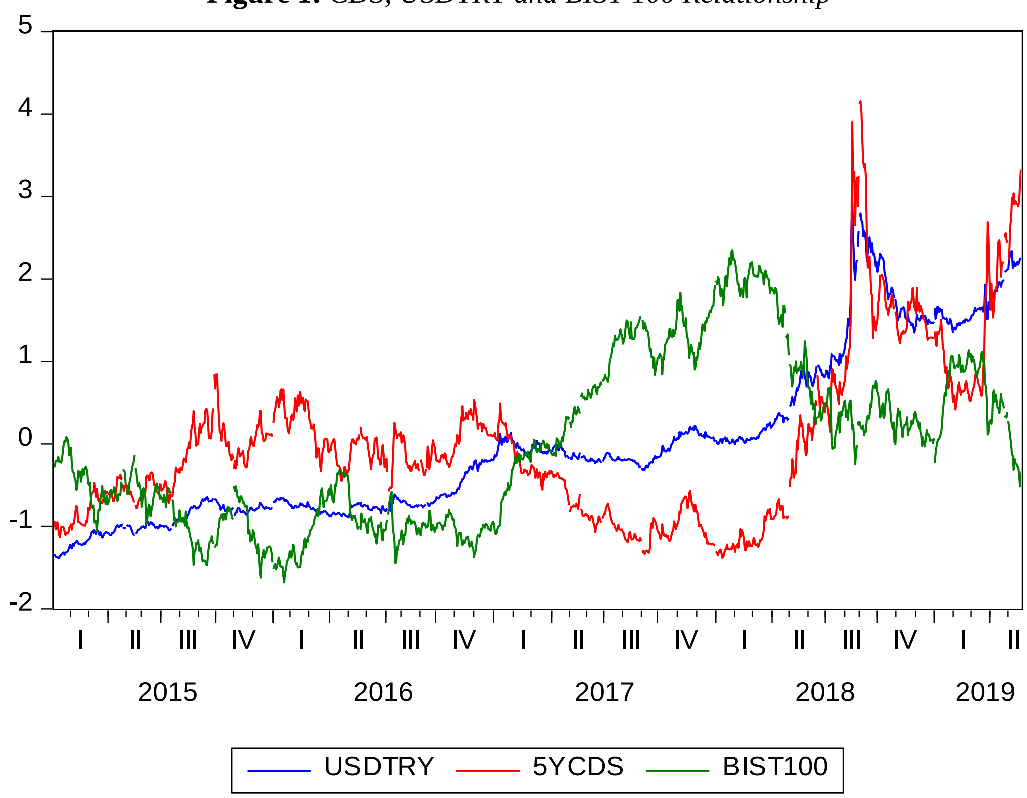
$$\ln(h_t) = \alpha_0 + \alpha_1 \left(\frac{\varepsilon_{t-1}}{h_{t-1}^{+0.5}}\right) + \lambda_1 \left| \frac{\varepsilon_{t-1}}{h_{t-1}^{0.5}} \right| + \beta_1 \ln(h_{t-1}) + \gamma_1 R_{BIST100} + \gamma_2 R_{5YCDS} + \gamma_3 \frac{ln(BIST\ 100)}{ln(5Y\ CDS)}$$

5. Empirical Results

Since the beginning of 2015 the relationship between CDS and USDTRY began to diverge after 2016 till September 2018. After September 2018 they began to diverge again. CDS markets reflect risk perceptions about the financial health of countries by providing signals for financial stability. Since they are the most liquid instruments in financial markets, they have a strong risk representation role. FX rate volatility is also an important risk indicator of economy in Turkey. If the FX rate volatility increase the borrowing cost of Turkey will also increase which will affect CDS rates via a transmission mechanism.

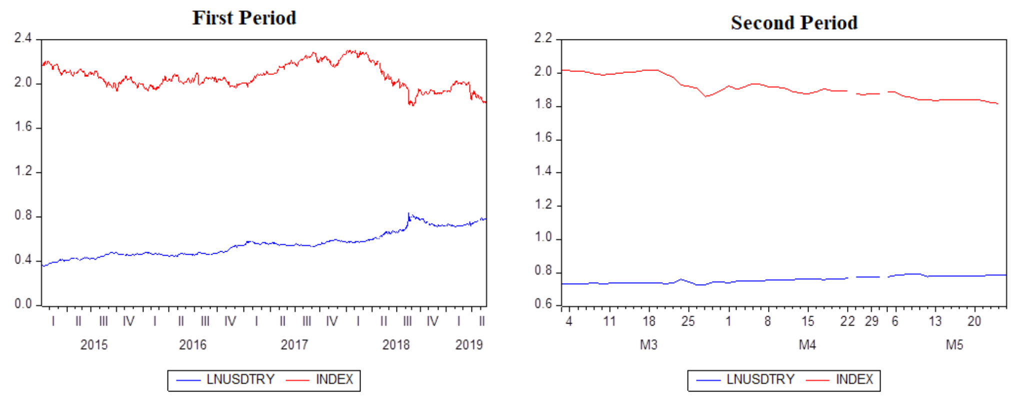
In Figure 1 the opposite relationship between CDS rates and stock markets is exhibited based on normalized time series data. FX rate sways between CDS and stock markets like an outcome of financial stability which inspired us to generate Index explanatory variable as the proportion of BIST 100 to 5Y CDS.

Figure 1: *CDS, USDTRY and BIST 100 Relationship*



In Figure 2 we can see the relationship between Index that we have generated and FX rates. On the left-hand side first period is exhibited while on the right-hand side second period is exhibited. The correlation of Index and FX rates increase significantly in the second period which they converge to each other which enables us to comment that in such high volatility times Index and FX rate convergence can be a simple indicator for investors to make decision.

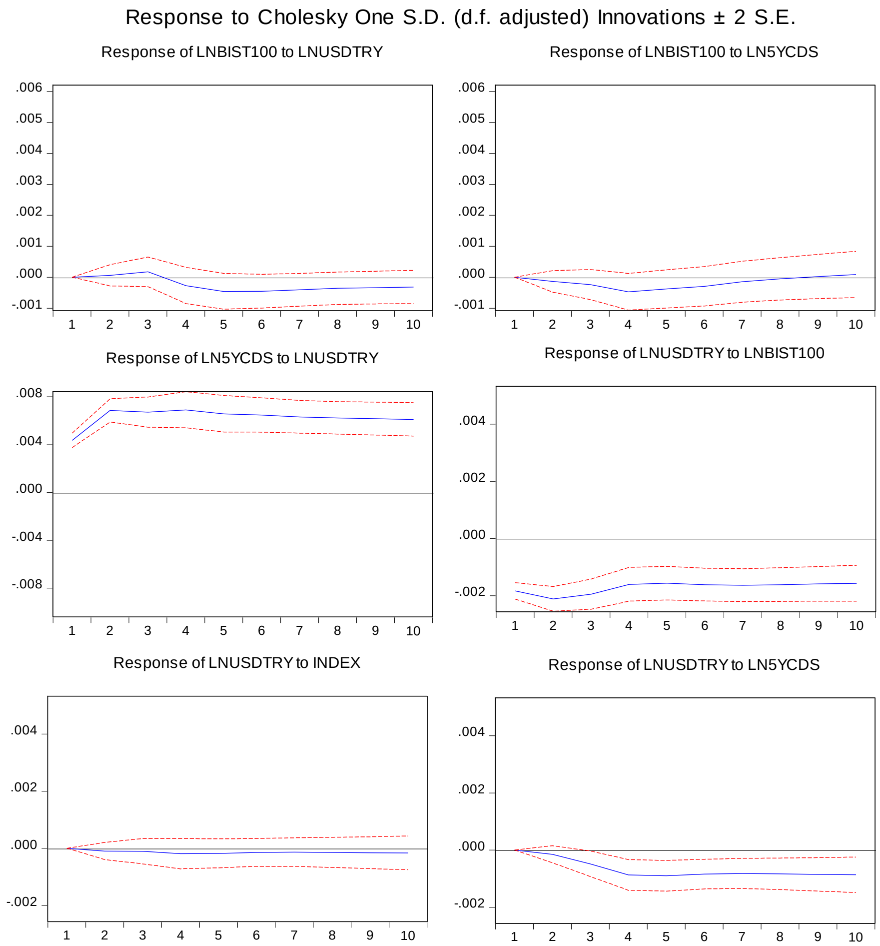
Figure 2: *FX Rates vs Index Relationship*



In Figure 3, the graphs cover the first period starting from the beginning of 2015. According to the impulse-response analysis[3] shocks on Index has a negative impact on FX markets for two days which does not fade away even in 10 days period. Shocks on CDS has a negative impact on USDTRY rates. After three days the impact of CDS shocks on FX rates is absorbed. Finally shocks on Borsa Istanbul has a negative impact on FX rates which is absorbed very quickly within two days.

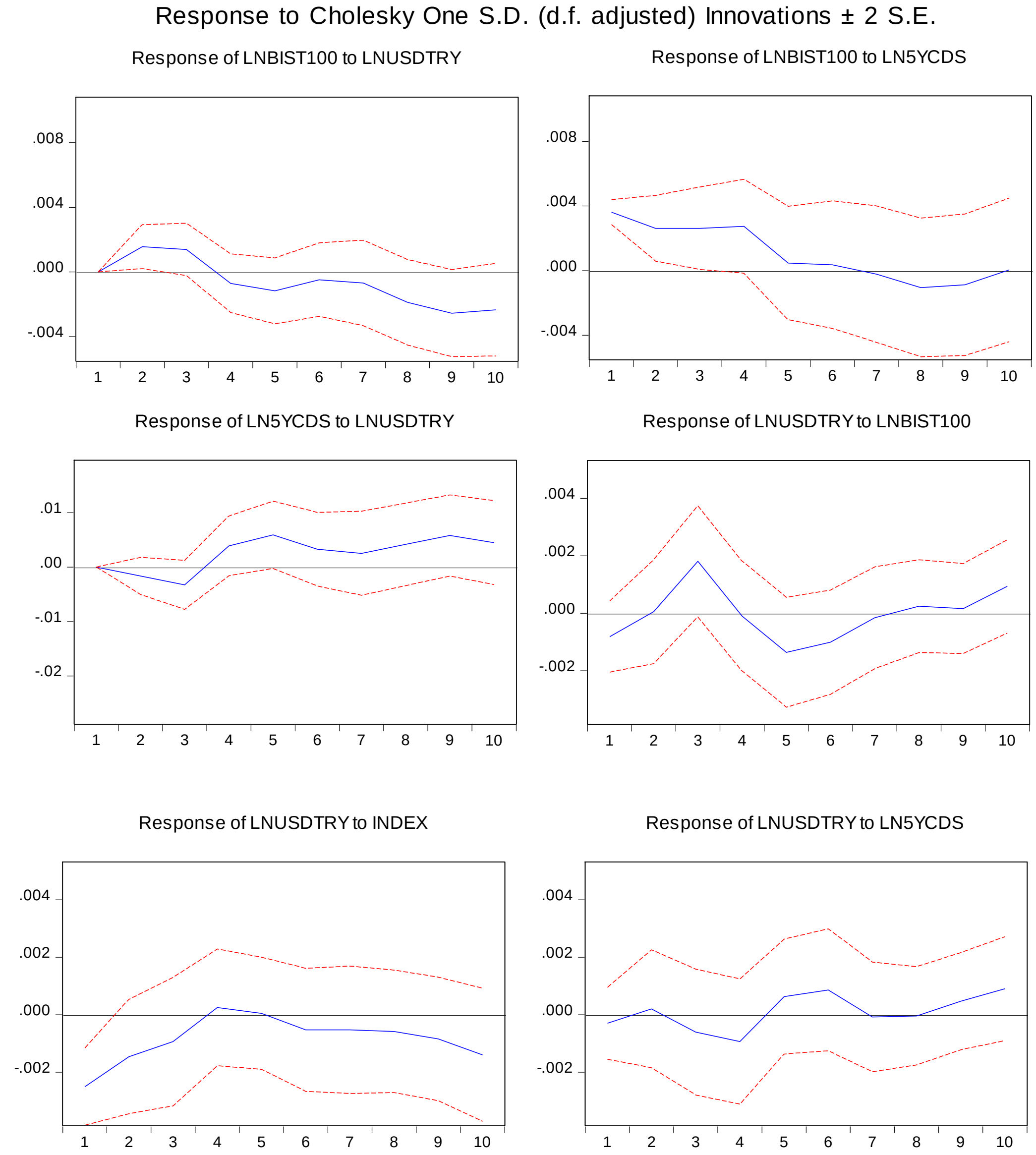
[3] Impulse response analysis are based on related VAR models which are constructed after the conintegration test between FX, CDS and stock markets. We used 4 lags in the VAR models and. VAR models are based on both long term and short term data sets which are the same datasets in EGARCH models.

Figure 3: *Impulse Response Analysis-First Period*



The impulse response analysis was also tested with second period data and the first finding is that deviation of responses in the second period are higher than the responses in first period (Figure 4). Response of stock markets and CDS to USDTRY shocks are quite the opposite of first period in swap wars period. FX market shocks have a positive impact on stock markets and a negative impact on CDS which fades away after three periods. USDTRY also responses differently to CDS, stock market and INDEX shocks in second period compared to the results in Figure 3. Stock market shocks and CDS shocks have positive impact on USDTRY for three and two periods respectively.

Figure 4: *Impulse Response Analysis-Second Period*



In Table 2 we see the Granger Causality test results. According to the tests there is one-way relationship from USDTRY to both BIST 100 Index and 5Y CDS rates. Only in the second period there is two-way relationship between USDTRY and 5Y CDS. Granger causality also runs one-way from 5Y CDS to BIST 100 Index and not the other way. These results are compatible with equation 4.8 since credit default spread is a function of recovery rate and probability of default. Any significant FX shock increases the probability of default and decreases the recovery rate of the country which increases CDS rates. According to the causality relationship CDS is a driver of BIST 100 index which makes us to conclude that controlling or managing FX rates will enable the financial markets to enjoy favorable CDS rates and higher stock markets returns. This is what Turkey's central bank has done by using short-term borrowing in the form of swap transactions to polish its foreign currency reserves in April 2019.

In the first period correlation coefficients between USDTRY and 5Y CDS is 0.60 while in second period it increased to 0.83. For USDTRY and Bist 100 Index correlation coefficient is 0.53 in the first period while it is -0.81 in the second period. The swap rate elevations of CBRT heightened concerns among investors over Turkey's ability to defend itself it if faces a new economic crisis which ended up a sinking stock market index in that period.

Table 2: *Granger Causality Tests*

Null Hypothesis:	First Period Obs	F-Statistic	Prob.	Second Period Obs	F-Statistic	Prob.
LNBIST100 does not Granger Cause LN5YCDS	1075	1.6332	0.1484	51	0.7735	0.5746
LN5YCDS does not Granger Cause LNBIST100		**2.8260**	**0.0153**		**1.9116**	**0.1139**
LNUSDTRY does not Granger Cause LN5YCDS	**1075**	**9.9752**	**0.0000**	51	**6.3621**	**0.0002**
LN5YCDS does not Granger Cause LNUSDTRY		0.2149	0.9562		**1.9676**	**0.1046**
LNUSDTRY does not Granger Cause LNBIST100	**1076**	**2.1319**	**0.0594**	52	**3.8000**	**0.0064**
LNBIST100 does not Granger Cause LNUSDTRY		0.3243	0.8985		0.4127	0.8372

In Table 3 EGARCH[4] models are represented for two different periods separately. For the first period returns of Borsa Istanbul has a negative impact on USDTRY FX rate returns while CDS returns have a positive impact. For the mean equation this relationship is still valid for the second period as well. In first period Index is statistically significant and has a negative impact on volatility of USDTRY returns. However when we observe the relationship between foreign exchange rate, stock market index and CDS in the last years we see that via public banks government has a tendency to manage the FX rates in the markets. This "managed FX rate" market seems to break the wheel of economy and financial market transmission mechanism. Moreover, in the second period the sign of the impact changes and Index has an increasing impact for volatility of FX returns. Moreover, in first period model, Index has a volatility decreasing impact on USDTRY return however in swap wars period it loses its explanatory power. Also the CDS becomes statistically insignificant in the second period model to explain USDTRY volatility.

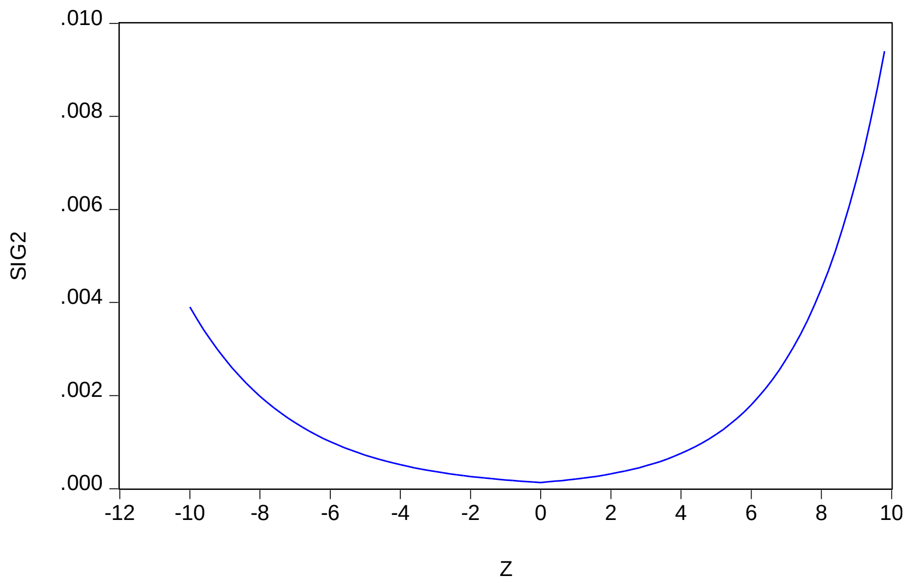
[4] We included stock returns and CDS returns both in the mean equation and the variance equation since returns have impact both on returns and error terms. Including them in variance equation also enables us to decompose the news effect on FX returns and normalize the process.

Table 3: *RUSDTRY EGARCH Models*

Period	First Period				Second Period			
	Mean Equation		Variance Equation		Mean Equation		Variance Equation	
	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats	coefficient	z-stats
c	0.0007	3.6498			0.0033	5.6482		
RBIST100	-0.1536	-8.5091	7.3456	4.5569	-0.1912	-4.3626	-60.8194	-2.1496
R5YCDS	0.1399	15.9283	4.7623	5.8722	0.1104	2.9636	0.8421	0.1396
LNBIST100/LN5YCDS			-0.5952	-4.1328			2.2204	1.3716
α_0			-0.6342	-2.8713			-6.3459	-2.1335
α_1			0.0483	1.4031			1.0727	3.6182
λ_1			0.3865	7.5160			0.5497	1.1361
β_1			0.8393	28.3149			0.8390	11.0495
Observations	1080				56			
R^2	0.2722				0.0063			
DW	1.9164				1.6686			

λ_1 is for the effect of size while α_1 is for the effect of sign. Since $\alpha_1$is positive good news will increase volatility more than bad news of the same size does which is contradictory with general exchange rate behavior. In Turkey's case good news is mainly FED driven external impulses or easing of political conflict with our border neighboring countries. In Figure 5 News Impact Curve also validates our findings.

Figure 5: *News Impact Curve for RUSDTRY EGARCH Model*



6. Conclusion

Several studies have investigated the relationship between macroeconomic factors and CDS among the financial markets. In this study, we draw the attention to USDTRY return and volatility relationship between CDS and stock markets. In recent years the inconsistency between this trio results with unfavorable credit ratings for Turkey compared to peer emerging market countries which made Turkey's banks and financial institutions to buy 85.05% of JCR Eurasia, the local unit of Japan Credit Rating Agency[5]. A sustainable economic growth model and financial stabilization along with political alignment will provide lower probability of default and higher recovery rates which will end up with lower CDS rates. Consequently, lower CDS rates will attract funds to stock markets and as a result FX rates will stabilize. However, according to our causality tests and impulse response analysis we see that this transmission mechanism works quite the opposite way by managing FX markets with CBRT and government policies with tools such as TRY swaps. However when we observe the relationship between foreign exchange rate, stock market index and CDS in the last years we see that via public banks government has a tendency to manage the FX rates in the markets. This "managed FX rate" market seems to break the wheel of economy and financial market transmission mechanism. When there is such noise in market specific indices such as the Index we incorporated in EGARCH models can be a good guide to assess both risk and return for FX market with only one indicator. In our models we observed that Index is statistically significant and can be good measure to check the market direction. As a result, an artificial stabilization is settled in markets but sustainability of this balance is a big question mark and is subject to further analysis.

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