

Re-visiting exchange rate volatility – risk perception relation. New evidence from Fourier tests

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Abstract. *It is essential to predict what the exchange rate will be in the future. There are several factors affecting value of national currency of an economy. One of them is risk perception and after the end of “Quantitative Easing” program by Federal Reserve, risk perception for emerging market economies has changed.*

In this study, we aim to analyze interaction between credit default swap premium as a risk indicator and exchange rate in the Turkish economy after the global finance crisis. Results imply that risk perception has essential effects on the value of Turkish lira against U.S. dollar and to reduce volatility in the value of Turkish lira, risk perception has to be decreased.

Keywords: Turkish lira, Fourier causality, credit default swap premium, exchange rate volatility, risk perception.

JEL Classification: F31, F60, G15.

1. Introduction

When financial investors buy a bond, they take some risks; these are credit risk, liquidity risk and interest rate risk. Among them, credit risk can be insured against a third party by the Credit Default Swap (CDS, hereafter) contracts. According to Bursa and Tatlıdıl (2015), it is possible to call CDS as a credit risk indicator and it reflects opinion of investors about economies and financial markets. On the other hand, interest rate risk and economic uncertainty are highly efficient on CDS and investors' risk perception (Fettahoğlu, 2019, p. 269).

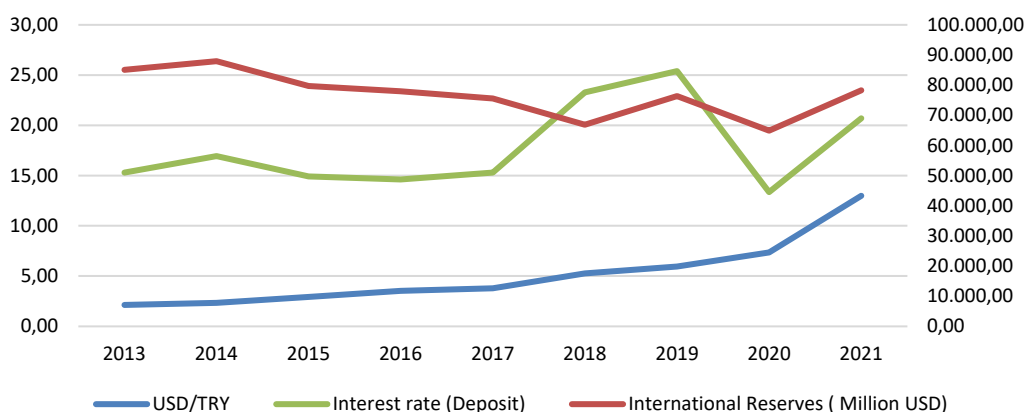
Originally, CDS is a kind of insurance contract. These types of contracts aim to protect buyer against losses from a credit event associated with an underlying reference entity (Amato, 2005, p. 56). Also, investors use CDS premiums for different purposes. Some of them are: speculation, hedging from country risk, and arbitrage.

As can be seen CDS premium is a useful risk measure indicator for especially sovereign economies. It is both useful for policymakers in deciding policy will be implemented and for investors while taking decisions about investments.

If an economy's CDS premium is high, it is a sign of an unpredictable territory for financial market. An increasing CDS premium of an economy would increase economic risk (Gök and Kara, 2021, p. 426). So, economic indicators might fluctuate due to increasing risk in the related economy, such as interest rate, exchange rate and stock prices, etc. In the light of these explanations, it is possible to conclude that CDS premium level can be useful for estimation of economic variables in the future as a risk perception measure.

There is no doubt that Global Finance Crisis in 2007/8 induced to modify behaviors of investors in global financial system. Investors were willing to invest their portfolios to emerging market economies rather than U.S. financial system and/or other advanced financial systems. Quantitative Easing program of Federal Reserve and expansionary policies of other advanced economies. Another modification in behavior of investors experienced in May 2013. By the end of QE in 2013, capital outflow from emerging market economies was experienced.

This experience resulted increasing exchange rate, increasing interest rate and reducing international reserves. The Turkish economy is one of the emerging market economies mentioned above. Moreover, indicators mentioned belonging to the Turkish economy are presented in the following graph.

Figure 1. Macroeconomic indicators of the Turkish economy (2013-2021)

Source: International Monetary Fund, International Financial Statistics (Access date: 20.02.2023).

As can be seen after 23rd of May 2013, national currency Turkish lira has entered a volatile period and started lose its value. By the second part of 2018, volatility has increased and in 2021, Turkish lira lost against U.S. dollar 30% of its value in a single month. It is possible to conclude that volatility in the value of Turkish lira has been increasing.

In the light of developments in the Turkish lira, the questions “What is the drivers of value of Turkish lira and/or is risk perception an important determinant for Turkish lira?” have to be answered. For this reason, we investigate possible relation between value of Turkish lira against U.S. dollar and CDS premium as a risk measure by employing Fourier based econometric tests. Although there is a number of studies investigating CDS – exchange rate relation in the literature, we aim to test if there is a difference in the relation after the end QE. Moreover, by employing Fourier based econometric methods, we hope to analyze it in the context of cyclical behavior. In the second section, empirical literature is summarized. In the third section model and data is introduced. In the following section, empirical findings are presented, and the last section implies political interpretations in the light of empirical findings.

2. Empirical literature

CDS premium is subject to many studies investigating relation between risk and different macroeconomic indicators. Current account balance, import volume (Georgievska et al., 2008), government debt to GDP and reserves to debt (Catao and Sutton, 2002), debt to GDP and high inflation (Mellios and Blanc, 2006), economic growth (Baek et al., 2005) are some of macroeconomic variables analyzed. No doubt, there are different type of relation between CDS. While some of them induce volatility in CDS premium, others are affected by CDS premium changes.

The literature reviewing relation between CDS premium as a risk perception and exchange rate takes the topic into account from different perspectives. There might be causality

running from exchange rate to risk premium: A depreciation in value of national currency would increase risk premium due to possible effects reducing value of national currency; increasing debt, increasing poverty, etc. Another view is that a change in risk perception might change value of national currency. Increasing risk in an economy would accelerate capital outflows. So, the value of national currency against other currencies will reduce.

The literature implying that risk perception induce volatility on value of national currency is larger than the literature supporting efficiency of exchange rate on risk perception. Early studies investigating the relation belongs to Carr and Wu (2007). They analyze possible relation between CDS spreads and currency option market in the Brazilian and Mexican economies. In the latter study, Zhang et al. (2010) investigate relation CDS spreads and exchange rate in four developed economies namely, Japan, United States, Australia and Eurozone. Results indicate that CDS spreads is effective on exchange rate in all economies. Later studies mainly focus on European Union economies after the crisis and employ CDS premiums to measure effect of risk perception on various indicators. One of them belongs to Hui and Chung (2011). They use CDS spreads to test effects of risk on fiscal conditions of Euro zone member countries. Bekkour et al. (2015) analyze the effect of CDS premiums on Euro and find that especially after the debt crisis, risk is an important factor effective on the value of euro. On the other hand, in previous study of Omachel and Rudolph (2014), it is found that there is a weak causation linkage between CDS premium and exchange rate in post-crisis period.

Hui and Fong (2015) take Japan, Eurozone and United Kingdom economies into account and they find also positive linkage running from CDS premium to exchange rate. In the study of Della Corte et al. (2015), make a broader analysis of developed and developing economies in the context of CDS premium and exchange rate relation. They find that CDS premium is an effective factor on both spot price of national currency and currency options.

As can be seen, investigations focus on advanced economies. Studies analyzing the Turkish economies are limited. One of the studies belongs to Turguttopbaş (2013). She analyzes six countries including Türkiye and tries to find effects of CDS on various financial indicators. According to author, in four of six countries, they are emerging market economies, CDS is very effective on the value of national currencies against U.S. dollar. Yılmaz and Çetiner (2017) analyze the relation in the opposite way for the Turkish economy and try to find effects of current account deficit and exchange rate on the CDS premium of Türkiye. According to authors, both of them is effective on CDS premiums. Hassan et al. (2017) conclude that CDS premium is an effective indicator in determining value of Turkish lira against U.S. dollar in different cycles of conjunctural fluctuations. But power of efficiency differentiates in different regimes. Kahyaoğlu (2019) also analyzes the Turkish economy in the context of exchange rate – CDS premium relation. Different from other studies, she implies that exchange rate is an important source of risk premium, and it is possible to observe exchange rate movement as an indicator of risk changes.

Lastly, Gök and Kara (2021) implement different causality analyses to find possible relation between interest rate, exchange rate and CDS premium in the Turkish economy. They find bi-directional causality between exchange rate and CDS premium and this result is confirmed by linear and non-linear econometric methods.

3. Model and data

In this study, we test relation between risk perception and exchange rate. To follow risk perception behavior, we employ credit default swap premium (CDS, hereafter). Authors investigating effects of risk on financial variables used several indicators. But after global finance crisis CDS premium has become popular to measure risk in financial markets. To measure change in the value of national currency, exchange rate is commonly used. We also employ value of Turkish lira against U.S. dollar. Moreover, we put realized version of exchange rate into model to sterilize inflationary effects.

According to common acceptance, an increase in CDS premium means increasing risk in the economy via financial markets, via versa. Similarly, an increase in real exchange rate means that national currency is depreciating. So, an increase in real exchange rate decreases value of national currency. In that case, increasing CDS premium would increase real exchange rate also and/or rising real exchange rate would induce to increase in CDS premium, as mentioned literature review section. In the light of explanations, our hypotheses will be as follows:

H0: CDS premium affects real exchange rate positively.

H1: CDS premium does not affect real exchange rate.

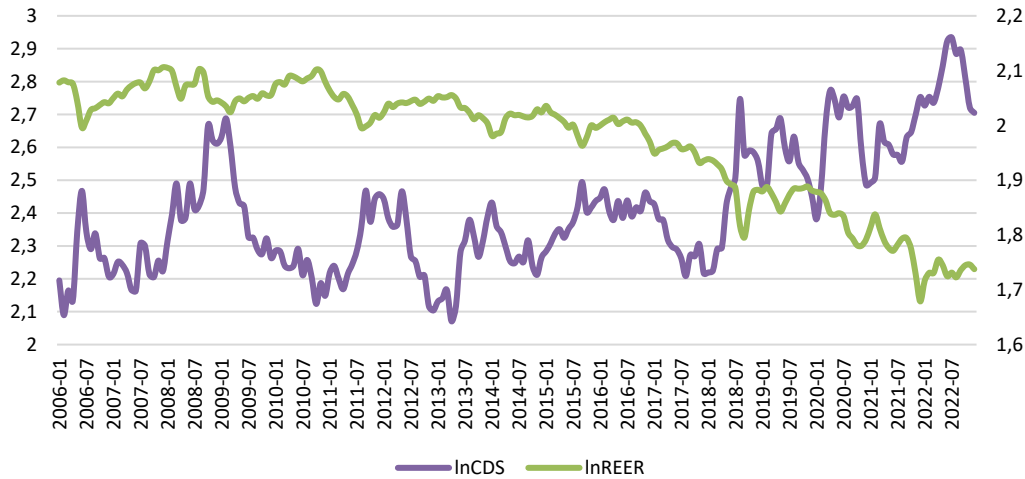
H0: Real exchange rate affects CDS premium positively.

H1: Real exchange rate does not affect CDS premium.

To test hypotheses, we employ data belonging to the Turkish economy. We put real exchange rate and 5-year CDS premium into model. Data belonging to CDS premium is obtained from Bloomberg data terminal and data belonging to real exchange rate is obtained from database of International Monetary Fund, called International Finance Statistics (IFS, hereafter) and calculated by authors. Time interval contains May 2013 – December 2022 period. Period begins by the end of Quantitative Easing program and ends by latest data available. Finally, monthly data is used. Acronyms of CDS premium and real exchange rate are CDS and REER, respectively.

4. Empirical findings

In the analysis of relation between CDS premium and real exchange rate, first step is to take natural logarithms of the series to solve heteroscedasticity problem. Movement in the series are presented in Figure 2. According to graph, trend of CDS turns to positive after 2013. While it is volatile during the period, there is a big break in the second part of 2018. This is common in the series as can be seen, especially after 2018. In the beginning of 2022, another hike occurred and in July 2022, there is the highest value of CDS. On the other hand, real exchange rate reached its highest value in October 2010 and decreases gradually until December 2021.

Figure 2. Movement of *lnCDS* and *lnREER* variables

In the second step, correlation coefficients of variables are found, and descriptive statistics are presented in the Table 1. In order to solve heteroscedasticity, natural logarithms of series are used. Correlation coefficient implies that there is a negative interaction between variables, and it is almost high. The Kurtosis distribution of both variables is flat. According to the Jarque-Bera test, the alternative hypothesis that there is no normal distribution for both variables at the 1% significance level is accepted.

Table 1. Correlation and descriptive statistics

	<i>lnCDS</i>	<i>lnREER</i>	Mean	Max.	Min.	Skew.	Kurt.	Jarque-Bera
<i>lnCDS</i>	1	-	2.40	2.93	2.07	0.66	2.73	15.52 (0.00)***
<i>lnREER</i>	-0.805	1	1.97	2.10	1.67	-0.94	2.69	30.94 (0.00)***

Notes: Values in parentheses show asymptotic probability values.

***, ** and * indicate that alternative hypotheses are accepted in significance levels 1%, 5% and 10%, respectively.

In the third step, unit root test is applied. Results of FKPSS test developed by Becker et al. (2008) is presented in Table 2. According to results, series belonging to both variables are not stationary in level. The real exchange rate variable contains unit root in model with constant 1% significance level and in model with constant and trend 10% significance level. The CDS variable contains unit root in model with constant in 1% significance level. For this reason, in the analysis, first difference of the series has to be employed.

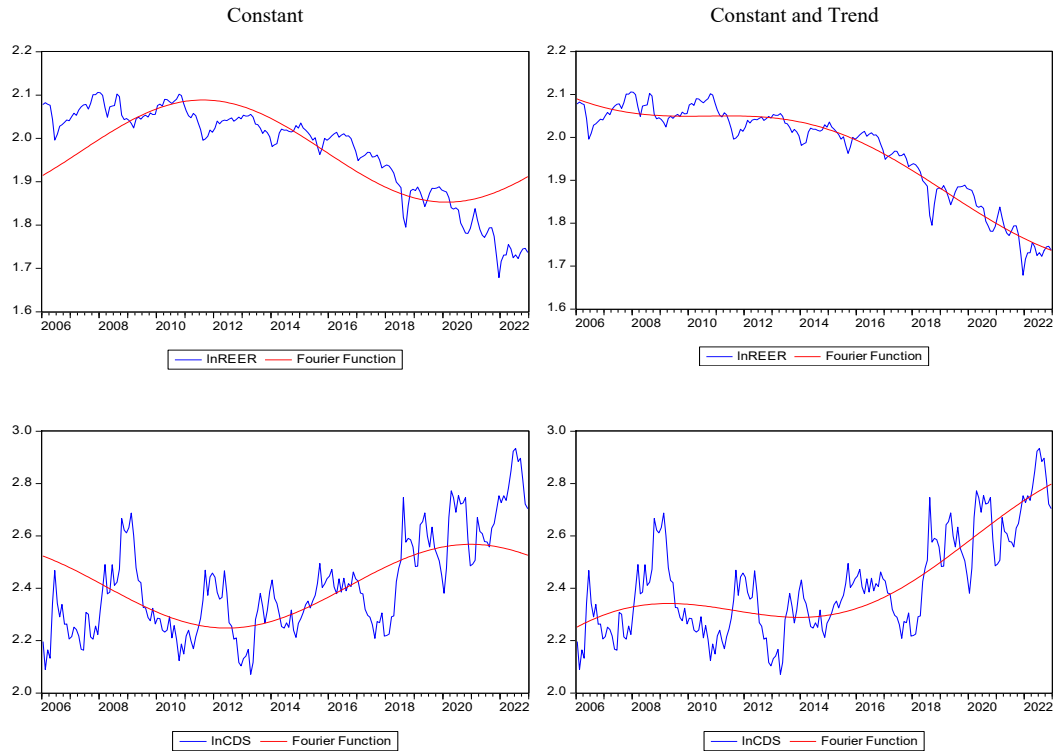
Table 2. FKPSS test results

<i>lnREER</i>	Frequency (k)	FKPSS
Constant	1	0.656***
Constant and Trend	1	0.053*
<i>lnCDS</i>		
Constant	1	0.451***
Constant and Trend	1	0.030

Notes: In FKPSS test, for $k=1$, 10%, 5% and 1% significance levels critical values for model with constant are 0.131, 0.172 and 0.269, respectively, for model with constant and trend are 0.047, 0.054 and 0.071, respectively. ***, ** and * denote that alternative hypothesis in 1%, 5% and 10% significance levels, respectively.

According to graph below, lnREER has a negative trend in the model with constant and trend. On the other hand, cyclical behavior occurs in the model with constant. On the contrary, lnCDS has a positive trend in the model with constant and trend. On the other hand, cyclical behavior occurs in the model with constant.

Figure 3. Fourier quantile functions of lnREER and lnCDS



To understand effect of CDS premium on real exchange rate, Fourier lag distributed autoregressive model where CDS premium is independent variables and real exchange rate is dependent variable is as follows.

$$\Delta \ln REER_t = \delta_0 + \delta_1 \sin\left(\frac{2\pi kt}{T}\right) + \delta_2 \cos\left(\frac{2\pi kt}{T}\right) + \delta_3 \ln REER_{t-1} + \delta_4 \ln CDS_{t-1} + \sum_{i=1}^{p-1} \phi'_i \Delta \ln REER_{t-i} + \sum_{i=1}^{p-1} \phi'_i \Delta \ln CDS_{t-i} + \varepsilon_t \tag{1}$$

In the equation, δ_0 denotes constant term, δ_1 and δ_2 denote sinus and co-sinus Fourier functions respectively. Lastly, δ_3 and δ_4 denote coefficients of real exchange rate and CDS premium, respectively.

Table 3. FARDL cointegration test results

Optimal Frequency	min AIC			
0.1	-6.141			
	Test Statistics	90%	95%	99%
F_A	6.179*	5.702	7.466	8.201
t	-3.190*	-3.114	-3.506	-3.963
F_B	1.284	1.037	1.787	2.830

Notes: ***, ** and * show that alternative hypothesis is accepted in significance levels 1%, 5% and 10%, respectively.

In the Fourier cointegration test developed by Banerjee et al. (2017), null hypothesis claims that there is no Fourier cointegration exists. Alternative hypothesis implies that there is a Fourier cointegration relation exists. According to F_A , F_B and t statistics, alternative hypothesis is accepted in 10% significance level. So, according to cointegration test results, there is an interaction between variables even in the long run. Results also indicate that although the optimal frequency is 0.1, it indicates that the permanence of the shocks to the model is low.

Table 4. FARDL long term parameters

	FMOLS	DOLS	CCR
	Parametre	Parametre	Parametre
δ_4	-0.081 (0.00)***	-0.085 (0.00)***	-0.081 (0.00)***
δ_0	-0.244 (0.385)	-0.242 (0.43)	-0.242 (0.385)
δ_1	0.294 (0.00)***	0.299 (0.00)***	0.293 (0.00)***
δ_2	2.480 (0.00)***	2.486 (0.00)***	2.479 (0.00)***

Notes: ***, ** and * denote that alternative hypothesis is accepted in significance levels 1%, 5% and 10% levels, respectively. FMOLS, DOLS and CCR are acronyms of Fully Modified Ordinary Least Squares, Dynamic Ordinary Least Squares and Canonical Correlation, respectively.

In the Table 4, FARDL long run estimators' results are presented. They are FMOLS, CCR and DOLS. According to three estimators, constant term is statistically insignificant. Coefficients of sinus and co-sinus function of $\ln CDS$ are statistically significant in 1% significance level. In May 2013 – December 2022 period, if $\ln CDS$ increases 1%, $\ln REER$ will decrease approximately 0.8%.

This is compatible with theoretical explanations. Because an increase in $\ln CDS$ means that risk premium of the Turkish economy and it would induce capital outflow. Increasing outflow would reduce real exchange rate.

Table 5. Fourier causality test results

Ho: $\ln CDS$ is not Granger cause of $\ln REER$						
	Wald	Asymptotic Probability Value	Bootstrap Probability Value	k	p	d_{max}
Fourier Standart Granger single frequency	32.837	0.00***	0.00***	1	2	-
Fourier Toda-Yamamoto single frequency	20.224	0.00***	0.00***	1	3	1
Fourier Standard Granger cumulative frequency	32.544	0.00***	0.00***	3	2	-
Fourier Toda-Yamamoto cumulative frequency	21.988	0.00***	0.00***	3	3	1

Notes: a, b, c denote that alternative hypothesis is accepted in significance levels 1%, 5% and 10% levels, respectively. The number of bootstraps is 1000. k denotes optimal frequency. p denotes optimal lag length. d_{max} denotes maximum integration degree. Akaike Information Criterion is used to choose optimal lag length. Causality analyses based on Granger are developed by Enders and Jones (2016) and causality analyses based on Toda and Yamamoto are developed by Nazhoğlu et al. (2016).

According to various Fourier based causality analysis, there is a strong causality running from CDS premium to real exchange rate. Uni-directional causality from $\ln\text{CDS}$ to $\ln\text{REER}$ in Fourier causality tests based on single and cumulative frequencies imply that there is a uni-directional causality from $\ln\text{CDS}$ to $\ln\text{REER}$ in 1% significance level. That means risk perception affects the value of national currency against other currencies and this is compatible with theory.

5. Conclusion

Estimation of value of national currency is an important issue to predict. Because of effects of a depreciation in the currency would induce volatility in macroeconomic indicators. For this reason, prediction of the exchange rate is vital for policymakers. Especially, in the case of high exchange rate pass through effect in the economy, it would be more important. When predictability of exchange rate increases, it will be easier to interfere to exchange rate to manage macroeconomic indicators.

The Turkish economy is one of the emerging market economies and exchange rate pass through is relatively high according to empirical investigations. In this regard, prediction of exchange rate and use alternative instruments to estimate become more important to compare with other economies. For this reason, in this study, we investigate possible effects of risk premium on the value of Turkish lira against U.S. dollar and employ a battery of Fourier based econometric methods.

Fourier causality analysis implies that there is a uni-directional causality running from CDS premium to exchange rate. Similarly, FARDL long run parameters conclude that an increase in CDS premium induces reduction in the value of national currency. Lastly, correlation coefficient supports all findings obtained from advanced econometric tests. In the light of theoretical information and econometric findings, it is possible to conclude that risk perception is an important factor for the value of Turkish lira. For this reason, CDS premium can be used as an indicator of exchange rate movements.

On the other hand, effectiveness of risk perception on the value of Turkish lira brings another question into mind, “Why risk is important factor and how policy makers can reduce effectiveness of risk perception?”. Sensitivity of exchange rate to risk perception might come from fragility of the economy, financial markets’ lack of depth, deficit in balance of payment and risks about the firms. So, in order to stabilize exchange rate and reduce risk perception, policymakers have to take these issues into account.

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