Research article

The behavior of Sovereign Credit Default Swaps (CDS) spread: evidence from Turkey with the effect of Covid-19 pandemic

Mustafa Tevfik Kartal*

Strategic Planning and Investor Relations Directorate in Borsa İstanbul, İstanbul, Turkey

* **Correspondence:** Email: mustafatevfikkartal@gmail.com.

Abstract: This study examines how sovereign CDS spreads of Turkey behave in Covid-19 pandemic times by considering that CDS spreads reflect the riskiness, vulnerability, financial stability, and macroeconomic stability of countries and CDS spreads of most of the emerging countries have increased with the emergence of Covid-19 pandemic. Therefore, the study focuses on the year 2020 which includes before Covid-19 and Covid-19 pandemic times periods. In this context, daily data between 12.06.2019 and 06.16.2020, 6 independent variables, and 6 Covid-19 situations are analyzed by employing Multivariate Adaptive Regression Splines (MARS) method. The findings reveal that (i) influential factors on Turkey's CDS spreads are BIST100 index, VIX index, MSCI Turkey index, and USD/TL foreign exchange rates for the period which is before Covid-19 pandemic times; (ii) MSCI emerging market index, number of new deaths from Covid-19, USD/TL foreign exchange rates, weighted average cost of funds, number of new cases from Covid-19, and VIX index have effect on Turkey's CDS spreads in Covid-19 pandemic times, respectively; (iii) on the other hand, number of cumulative cases, number of cumulative deaths, and measures do not have effect on Turkey's CDS spreads in any period. Taking precautions to decrease negative effects on Turkey's CDS spreads by considering the importance of deaths number from Covid-19 pandemic is very important. Hence, Turkey could stimulate foreign portfolio investment inflows with decreasing CDS spreads.

Keywords: Covid-19; MARS; sovereign CDS spreads; variables; Turkey

JEL Codes: C22, E44, F30, G12, G15

1. Introduction

There are a variety of indicators in economies like economic growth, foreign exchange rates, inflation, interest rates which are significant in development of countries. Each indicator has an important role in terms of its effects in economies (Orhan et al., 2019). Besides, most of these indicators have effect on price stability, financial stability and macroeconomic stability in turn by affecting and reflecting the riskiness, soundness and vulnerability of countries. In this context, one of the main instrument is CDS spreads.

CDS are derivative instruments which are used for protection against default risks on debts securities by foreign investors (Hibbert & Pavlova, 2017; The Central Bank of the Republic of Turkey (CBRT), 2020a). There are two main types of CDS as either sovereign or corporate CDS (Shahzad et al., 2017), and sovereign CDS are related with countries' debts securities on which we focus on the study.

By considering that countries have been much more interdependent, multiple factors, which have effect on CDS spreads, should be taken into consideration. It is clear that global factors (fund flows, gold prices, market volatility, oil prices etc.) are not under control of countries itself. However, macro and market variables could be controlled mainly by countries which provides the decreasing contribution on CDS spreads.

CDS spreads can be evaluated as risk, financial stability, and macroeconomic stability indicator. Besides these, CDS spreads are significant for foreign investors in portfolio allocation decisions. This is not only a preference, but it also is a requirement which is resulting from the considering country risk, diversification of risks and finance theory (Dooley & Hutchison, 2009; Yang et al., 2018). For this reason, low-level CDS spreads have become one of the most important indicator for foreign portfolio investments which are very important for emerging countries because of the fact that they need much more (direct and portfolio) investments to be developed.

When examining current literature, it can be seen that, global, macroeconomic, and market variables affect CDS spreads of countries (Galil et al., 2014; Kocsis & Monostori, 2016). In this context, influential indicators must be followed up and directed by regulatory authorities of countries in order to decrease CDS spreads and hence stimulate foreign portfolio investments. Although starting point should be macroeconomic and market indicators, global indicators should also be considered. By this way, emerging countries are able to attract much more foreign investments.

On the other hand, all countries have been faced with Covid-19 which has become pandemic. It has originated from China at the beginning of the year 2020. There are totally 8.1 million disease cases, and 435 thousand deaths as of 06.16.2020 over the world (World Health Organization, 2020). Naturally, Covid-19 spreads to Turkey. The first case has been announced on 03.10.2020 officially. There are totally 181 thousand disease cases, and 4.8 thousand deaths as of 06.16.2020 (Turkey Ministry of Health, 2020). In this environment, all economic and financial indicators have been deteriorating in countries including Turkey. Therefore, this situation began to be called as "new normal", and new normal should be considered in making any analysis in macroeconomic and financial issues.

In the light of all information above, the study examines the behavior of Turkey's sovereign CDS spreads in recent times which includes before Covid-19 pandemic times and in Covid-19 times by employing MARS method. Daily data between 12.06.2019 and 06.16.2020 and 6 (3 global, 3 macro) indicators and 6 Covid-19 situations (presence, numbers of new cases, cumulative cases, new

deaths, cumulative deaths, increasing rates of new cases and new deaths, presence of measures) are considered for this aim. The study focuses on Turkey because of the fact that Turkey has quite high level of CDS spreads. Another important reason is that Turkey has the highest 6th CDS spreads among the all countries as of 06.16.2020. The study defines that the most influential factors on Turkey's CDS spreads vary according to the period which Turkey has been in Covid-19 pandemic or not. The results of the analysis shows the importance of number of new deaths and number of new cases from a common disease (Covid-19 pandemic) situation for CDS spreads of Turkey.

The main contributions of the study could be summarized as the study (i) uses MARS method which a non-parametric regression is building the functional relationship between variables without requiring any pre-assumption. Also, MARS method is used in the first time to examine CDS spreads of Turkey for making a comparison between before Covid-19 times and in Covid-19 times. Moreover, the study is a pioneer study in finance area in Turkey examining the relationship of Covid-19 with a financial issue, as far as known; (ii) examines the variables of Turkey's sovereign CDS spreads by using global, market, and Covid-19 related variables; (iii) examines recent times from 12.06.2019 to 06.16.2020 on daily basis which covers Covid-19 times (iv) focuses on solely Turkey which is 6th country on the world which has the highest CDS spreads.

The remaining parts of the study is organized as follows. Part 2 presents the conceptual framework. Part 3 explains the variables, data, and theoretical background of MARS method. Part 4 tells the empirical results and presents a discussion based on the findings of the study with recommending some proposals. Part 5 presents the conclusion.

2.   Conceptual framework

Because of the fact that emerging countries have mainly low-level savings, they need much more foreign investments both direct and portfolio in order to finance their growth so as to be developed. By considering foreign direct investments depend on a variety of global and macro conditions including geopolitical and political issues, emerging countries try to increase stimulating foreign portfolio investments. In this context, bonds/bills are main investment instruments.

Security investments to foreign countries, however, include country risks. This type of risks is higher especially for emerging countries. That is why because investors are doubtful about whether emerging countries will repay the borrowed funds or not. Therefore, foreign investors seek a protection shield against country risks. In this context, one of the main and important tool is CDS. CDS are used for protection against losses on foreign exchange rate (FER) denominated securities by foreign investors (Hibbert & Pavlova, 2017; CBRT, 2020a).

CDS buyer receives a compensation from CDS seller when issuer of the bonds/bills defaults. Amount of compensation is calculated based on CDS spreads on yearly base. Hence, CDS spreads have a role in reflecting the riskiness of the assets. An example, Turkey's 5-years sovereign CDS spreads are 640 basis points (implying 6.4% interest rates) as of May 5, 2020 whereas it was 276 basis points (showing 2.76% interest rates) as of January 1, 2020. So, CDS spreads are calculated as USD 640 thousand as of May 5, 2020 nearly multiplying by 2.5 times with regard to it was USD 276 thousand as of January 1, 2020 for each year throughout CDS maturity for USD 10 billion bonds/bills (Hasan et al., 2016). In this context, amount of foreign portfolio investments could be negatively affected from the increasing of CDS spreads which show the increasing of country risks. This is because of the fact that insurance of securities become more expensive.

As one of the most important and leading emerging country, Turkey has quite high CDS spreads. Figure 1 shows the development of Turkey's sovereign CDS spreads in 2020 including times of Covid-19 pandemic.
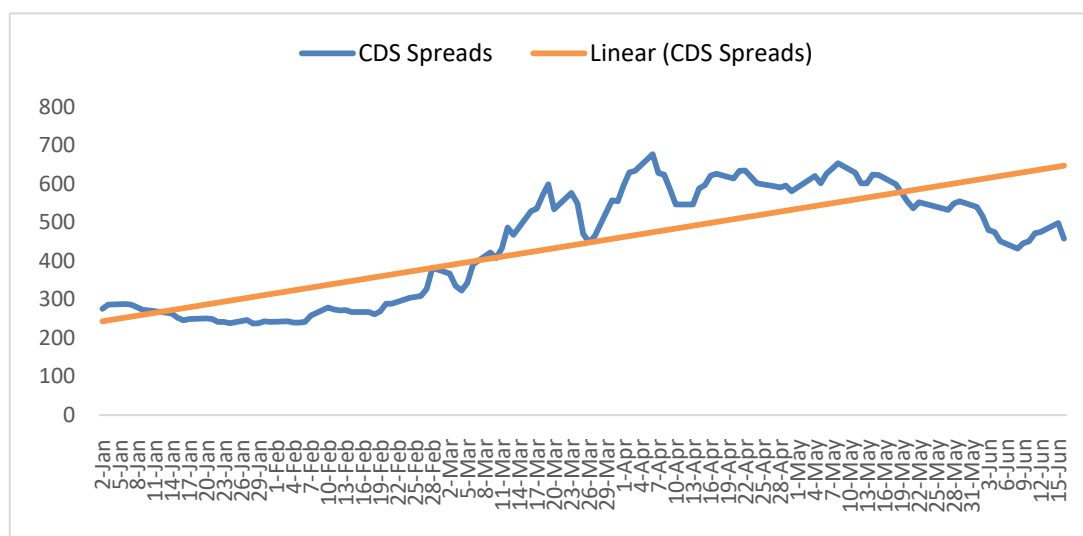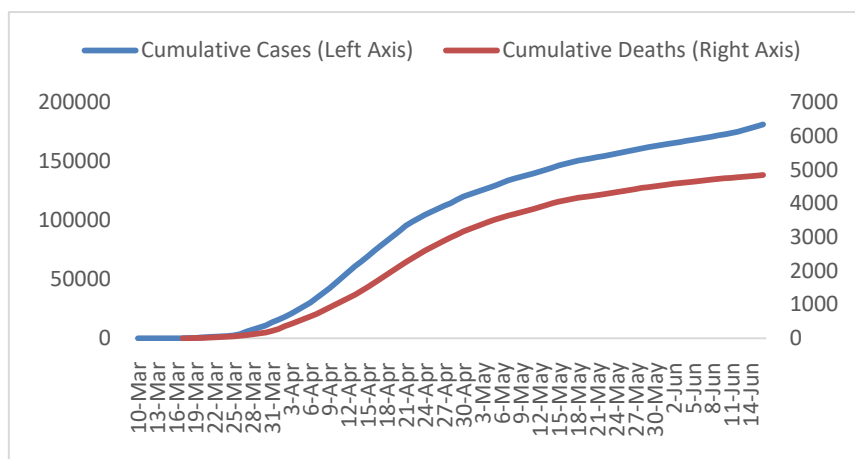

Figure 1. The Development of Turkey's CDS Spreads in 2020. Source: Bloomberg Terminal.

There is an increasing, quite volatile and high-level trend in CDS spreads of Turkey. This increase trend has begun to accelerate in February with the spreading of Covid-19 pandemic over the world. Also, CDS spreads peaked in April (677 as of 04.06.2020) in times at when Covid-19 pandemic has been accelerating in terms of new cases and number of deaths resulting from Covid-19 in Turkey. Although CDS spreads has decreased a bit in April, it has again increased in May and reached to the level of 640 points. As general, Turkey has quite volatile, increasing, and high-level CDS spreads which are a threat to provide sustainable foreign portfolio investment inflows.

In addition, Covid-19 pandemic has reached to Turkey. The first case was seen on 03.10.2020, and the first death was seen on 03.17.2020. Figure 2 shows the development of Covid-19 in Turkey.

Figure 2 shows that Covid-19 cases have been seen in Turkey since 10 March. Also, deaths have been seen since 17 March. Numbers of cumulative cases and cumulative deaths resulting from Covid-19 have been still increasing continuously in Turkey. Therefore, second and third waves are expected in Covid-19 pandemic in Turkey.

Figure 2. The Development of Turkey's Covid-19 Figures in 2020. Source: Turkey Ministry of Health, 2020.

Negative effects have been seen on Turkey's economy resulting from Covid-19. To prevent the occurrence or the degree of negative effects, Turkey's regulatory authorities have announced fiscal, monetary, and administrative measures since beginning of 2020 March. Some of them could be summarized as local lockdowns; quarantines on residential areas; closure of schools, social spaces; ban on flights; decrease on the minimum payment requirements of credit cards; increasing the amount of funding markets by CBRT including buying government bonds; deferred credit payments to banks; VAT, social security premium payments deferred for six months in various sectors; minimum wage subsidies; cash transfers to families in need; state banks to provide cheaper loans to firms promising not to lay off employees; hotel taxes deferred for six months; credit guarantee fund size increased. In addition to these measures, some companies like Akbank, Halkbank, and Vakıfbank have cancelled dividend distribution (Morgan Stanley, 2020).

Although a variety of measures have been taken in order to decrease or prevent the negative effects of Covid-19 pandemic on Turkey's economy, unfortunately negative developments have been seen on the economy. For example, FER have been increasing, current account deficit and foreign trade deficit have been increasing, and unemployment rate is expected to be increased for Covid-19 pandemic period. In addition, CDS spreads of Turkey have increased in Covid-19 period. While CDS spreads of Turkey was at the level of 407 points on 03.10.2020 which is the first date Covid-19 determined in Turkey, on the other hand, CDS spreads of Turkey have become 654 points on 05.08.2020. This condition suggests that Covid-19 pandemic has been causing an increase in CDS spreads of Turkey. That is why because Covid-19 pandemic has been an important and a main risk indicator for all developed and emerging countries including Turkey.

In this context, defining which factors have effect on Turkey's CDS spreads would be useful and to test whether Covid-19 pandemic has an effect on Turkey's CDS spreads or not. Therefore, the study focuses on examining the behavior of Turkey's sovereign CDS spreads before Covid-19 times and in Covid-19 times. Hence, the study could examine the effects of Covid-19 on Turkey's CDS spreads.

3. Variables, data, and method

3.1. Variables

The present literature includes various studies examining the relationship between sovereign CDS spreads and a variety of variables. These variables could be mainly grouped as under two groups which are global and macro factors. Besides these, Covid-19 pandemic situations are taken into consideration in the study.

In the first group, studies examine the effects of global factors on CDS spreads. There are Morgan Stanley Capital International (MSCI) emerging market index, MSCI Turkey index, and volatility index in this group. In some studies, equity market price is used (Cremers et al., 2008; Zhang et al., 2009). Similarly, Yang et al. (2018) use MSCI all country world index as a determinant. Therefore, MSCI indices are expected to be related with CDS spread. By considering Turkey is an emerging country, MSCI emerging market index and MSCI Turkey index are selected to be used and a negative relationship is expected with CDS spreads. In addition, as an indicator implying market volatility, volatility (VIX) index is quite related with CDS spreads of countries. A strong positive relationship is defined between VIX index and CDS spreads in studies of Galil et al. (2014), Hibbert & Pavlova (2017), Akçelik & Fendoğlu (2019), CBRT (2020a).

In the second group, studies examine the relationship between macroeconomic factors and CDS spreads. Variables related with FER, Borsa İstanbul (BIST), and CBRT present in this group. In the context of FER, USD/TL is considered since this is the most important and used FER in Turkey. According to the studies of Ertuğrul & Öztürk (2013), Fontana & Scheicher (2016), Hassan et al. (2017), a positive relationship is expected between FER and CDS spreads. Also, equity index is used to examine CDS spreads. In this context, main stock exchange of Turkey (i.e. BIST100 index) is considered. Alexander & Kaeck (2008), Galil et al. (2014), Lahiani et al. (2016), Cremers et al. (2008), Zhang et al. (2009) use equity index as a variable and they define a significant effect on CDS. By considering these studies, a negative relationship is expected between BIST100 index and CDS spreads. In addition, CBRT weighted average cost of fund (WACF) is considered as a variables in the study. This is expected to be related with CDS spread. A positive relationship is expected between WACF and CDS spreads.

In the third group, Covid-19 situations are taken into consideration. In this group, there are 6 variables related with the Covid-19 pandemic in Turkey which is seen since 03.10.2020.

As dependent variables, 5-years CDS spreads are used due to the fact that this is the most liquid CDS spread types (CBRT, 2020a). Moreover, Table 1 summarizes the details of independent variables taking place in the analysis.

Table 1. Details of independent variables.

Variable Group	Variable	Symbol	Description	Expected Effect
Global	MSCI Emerging Market Index	MSCIEM	MSCI Emerging Market Index	-
	MSCI Turkey Index	MSCITR	MSCI Turkey Index	-
	VIX Index	VIX	Chicago Board Options Exchange Volatility Index	+
Macro	USD FER	USD/TL	USD/TL FER	+
	BIST100 Index	BIST100	Trading Day Closing Value	-
	CBRT WACF	WACF	CBRT WACF (%)	+
Covid-19 Pandemic	Presence	CVD	1: If Covid-19 exist; 0: otherwise	+
	New Cases	NCASE	Number of New Cases	+
	Cumulative Cases	CCASE	Cumulative Number of Cases	+
	New Deaths	NDEATH	Number of New Deaths	+
	Cumulative Deaths	CDEATH	Cumulative Number of Deaths	+
	Measures	MEASURE	1: If any measures (monetary, fiscal, administrative etc.) are taken; 0: otherwise	-

Note: Positive (+) relationship means that CDS increase when independent variable increases.

Negative (-) relationship means that CDS decrease when independent variable increases.

Apart from the variables summarized in above which are selected to be used in the study, it is possible to mention about other variables. In the literature, bond spreads (Fontana & Scheicher, 2016), credit ratings (Galil & Soffer, 2011), economic growth (Benbouzid et al., 2017; CBRT, 2020a), industrial production index (Johnson, 2002; Sagi & Seasholes, 2007; Liu & Zhang, 2008; Galil et al., 2014), inflation (Galil et al., 2014; Benbouzid et al., 2017; Akçelik & Fendoğlu, 2019; CBRT, 2020a), and reserves (Akçelik & Fendoğlu, 2019; CBRT, 2020a). Data for these variables are announced quarterly or monthly basis. However, the study focuses on Covid-19 pandemic times which requires to work on daily base data. Therefore, such variables could not be included in the study.

3.2. Data

This study includes the period between 12.06.2019 and 06.16.2020. This period is selected to focus on the very recent period including Covid-19 pandemic times and the nearest times before Covid-19. For this reason, daily data is used in the study. In addition, data includes from 06.12.2019 to 03.09.2020 for the period which is before Covid-19 pandemic whereas data between 03.10.2020 and 06.16.2020 is included in Covid-19 pandemic times.

Data for CDS spreads, BIST100 index, VIX index, MSCI indices are gathered Bloomberg Terminal. Data for CBRT WACF and USD/TL FER are gathered from CBRT (2020b). Data for Covid-19 situations are gathered from Turkey Ministry of Health (2020).

Data for business days is considered because of the fact that data of some variables like FER and BIST100 can be obtained only for business day.

3.3. MARS method

MARS method is introduced by Friedman (1991). MARS is a non-parametric regression modeling of high dimensional data to estimate underlying functional relationships between variables. Although linear model regressions require some pre-assumptions, MARS does not have any pre-assumption. Also, MARS method is flexible, computational speed and accurate predictors of piecewise-defined polynomials from correlated data (Goh et al., 2017).

There is two-steps in MARS method. In first step, the algorithm starts from a constant term that is the mean of the dependent values. In second step, the piecewise linear segments, known as basis functions (BFs), are iteratively added to the model.

BFs are dependent on spline functions that are defined on a given segment and the end points of the segment are called knots. The forward step finds the potential knots to improve the performance and leads to overfitting.

MARS model can be formulated as follows:

$$Y = f(x) = B_0 + \sum_{k=1}^{K} a_n B_n(X_t) + \varepsilon \tag{1}$$

In which Y is the dependent variable and X represents independent variables. B_0 denotes the constant term and $B_n(X_t)$ describes the basis function that is estimated by minimizing the residual sum of squares. a_n shows the coefficient of nth basis functions (Friedman, 1991). In the backward stepwise stage (pruning stage), it can be eliminated the redundant knots that have the least contribution to the complex model by using Generalized Cross-Validation (GCV).

GCV can be determined as follows:

$$GCV(K) = \frac{1}{N} \sum_{i=1}^{N} [y_i - f(x_i)]^2 \Big/ \left[1 - \frac{K+dK}{N}\right]^2 \tag{2}$$

where d is the penalizing parameter for each basis function and N is the number of observations.

The best model is selected according to the highest coefficient of determination (R^2) and the lowest GCV value (Hastie et al., 2009).

The MARS method has not been used in the literature to examine CDS spreads as far as it is known. On the other hand, the method has high prediction capacity. Therefore, the MARS method is performed in this study by considering these facts. It is though that by employing the MARS method to examine CDS spreads make a contribution to the literature. Hence, the study has a characteristic which is a pioneer study in finance area in Turkey examining the relationship of Covid-19 with a financial issue.

4. Empirical analysis

4.1. All models

MARS creates all results which are obtained with 10-fold cross-validation approach and the best model is chosen based on GCV and R^2 statistics. Appendix 1 shows the all models which are produced by MARS method. Totally 22 models (BFs) are produced for both before Covid-19 pandemic times and in Covid-19 pandemic by MARS.

In addition, MARS shows the important thresholds of independent variables which is shown in Appendix 2 and 3. As it can be seen from these appendixes, there are interactions between BIST100 index and MSCI Turkey index; BIST100 index and VIX index; USD/TL FER and VIX; MSCI Turkey index and USD/TL FER; MSCI Turkey index and VIX index in the period which is before Covid-19 times. On the other hand, interactions are seen between MSCI emerging market index and number of deaths; MSCI emerging market index and number of cases; USD/TL FER and number of deaths; VIX index and number of deaths in Covid-19 pandemic times.

4.2. Variable importance

As a result of MARS analysis, BF9 is the best model in terms of the value of GCV and R^2 for the period which is before Covid-19 pandemic times. On the other hand, BF12 is the best model in Covid-19 pandemic times. 4 variables and 6 variables have a statistically significant effect on Turkey's CDS spreads in these periods, respectively. According to the determination, which is presented in Table 2, the most significant variable on CDS spreads of Turkey is BIST100 index for the period which is before Covid-19 pandemic. In addition, VIX index, MSCI Turkey index, and USD/TL FER have significance on CDS spreads of Turkey in this period. On the other hand, MSCI emerging market index, number of new deaths, USD/TL FER, WACF, and number of new cases are influential in Covid-19 pandemic times.

Table 2. Variable Importance.

Before Covid-19 Pandemic Times			In Covid-19 Pandemic Times		
Variable	Importance Level	-GCV	Variable	Importance Level	-GCV
BIST100	100.00	429.177	MSCIEM	100.000	2,906.607
VIX	79.567	303.918	NDEATH	91.866	2,520.902
MSCITR	43.033	151.003	USD/TL	63.669	1,437.044
USD/TL	35.847	131.653	WACF	43.247	897.408
			NCASE	30.813	669.828
			VIX	10.088	460.341

4.3. Descriptive statistics

Daily data includes 66 observations for the both period. Table 3 shows the descriptive statistics of the variables for the periods.

4.4. Analysis results (best models)

Table 4 presents the details of best model (BF9).
According to the best model (BF9), totally 4 variables also affect CDS spreads of Turkey in the period which is before Covid-19 pandemic times.
Table 5 presents the details of best model (BF12).

Table 3. Descriptive statistics.

Period	Variable	Observation	Average	Standard Deviation	Minimum	Maximum
Before Covid-19	CDS[1]	66	283.159	37.706	237.85	422.02
	MSCITR	66	1,506,688.15	62,963.455	1,357,979	1,615,513
	VIX	66	17.744	9.061	12.10	54.46
	USD/TL	66	5.977	0.106	5.78	6.24
	BIST100	66	115,716.301	5,111.936	103,524.023	123,556.102
In Covid-19	CDS[1]	66	556.608	67.291	407.11	677
	USD/TL	66	6.742	0.241	6.12	7.15
	MSCIEM	66	899.231	59.047	758.2	1,012.51
	NDEATH	66	48.409	39.06	0	126
	WACF	66	8.816	0.863	7.64	10.65
	NCASE	66	1,836.439	1,398.946	0	4,801
	VIX	66	42.151	15.046	24.52	82.69

Note: The dependent variable.

Table 4. Before Covid-19 pandemic times Turkey's Sovereign CDS spreads BFs.

Basis Functions	Details	Coefficient
	Constant	223.817
BF1	max(0, MSCITR-1,462,604)	-
BF2	max(0, 1,462,604-MSCITR)	−0.482987E-03
BF3	max(0, VIX-18.23)	3.058
BF4	max(0, 18.23-VIX)	-
BF5	max(0, BIST100-109,600.531) * BF2	−0.787367E-06
BF8	max(0, 118,341.523-BIST100) * BF4	−0.582810E-03
BF9	max(0, USD/TL-6.15) * BF3	19.274
BF14	max(0, 5.89-USD/TL)	125.673
BF16	max(0, 122,320.773-BIST100)	0.008
BF19	max(0, USD/TL-5.95) * BF1	0.003
BF26	max(0, 16.39-VIX) * BF1	0.418337E-04
F Test: 246.321 (0.000)	Adjusted R^2: 0.971	

Table 5. In Covid-19 pandemic times Turkey's Sovereign CDS spreads BFs.

Basis Functions	Details	Coefficient
	Constant	611.856
BF1	max(0, NDEATH-59)	4.504
BF2	max(0, 59-NDEATH)	−3.682
BF3	max(0, MSCIEM-842.540) * BF2	−0.012
BF4	max(0, 842.54-MSCIEM) * BF2	0.023
BF5	max(0, USD/TL-6.5) * BF2	10.146
BF7	max(0, NDEATH-98)	6.976
BF9	max(0, NDEATH-76)	−8.515
BF10	max(0, 76-NDEATH)	-
BF11	max(0, NCASE-311)	−0.014
BF13	max(0, MSCIEM-966.32) * BF11	−0.002
BF15	max(0, USD/TL-6.84) * BF10	6.444
BF17	max(0, VIX-45.41) * BF1	−0.427
BF19	max(0, WACF-8.91)	68.109
F Test: 171.252 (0.000)	Adjusted R^2: 0.969	

According to the best model (BF12), totally 6 variables also affect CDS spreads of Turkey in Covid-19 pandemic times.

Adjusted R2 of the best MARS model is 0.971 before Covid-19 pandemic times, and 0.969 in Covid-19 pandemic times. These results imply that the changes in Turkey's sovereign CDS spreads can be explained with the independent variables used in these models.

As a result of the analysis, the best model for Turkey's sovereign CDS spreads before Covid-19 pandemic times is estimated as follows:

$$\text{CDS Spreads} = 223.817 - 0.482987E - 03 * BF2 + 3.058 * BF3 - 0.787367E \\ - 06 * BF5 - 0.582810E - 03 * BF8 + 19.274 * BF9 + 125.673 \\ * BF14 + 0.008 * BF16 + 0.003 * BF19 + 0.418337E - 04 \\ * BF26 \tag{3}$$

model CDS = BF2 BF3 BF5 BF8 BF9 BF14 BF16 BF19 BF26.

In addition, the best estimated for Turkey's sovereign CDS spreads in Covid-19 pandemic times is determined as follows:

$$\text{CDS Spreads} = 611.856 + 4.504 * BF1 - 3.682 * BF2 - 0.012 * BF3 + 0.023 \\ * BF4 + 10.146 * BF5 + 6.976 * BF7 - 8.515 * BF9 - 0.014 \\ * BF11 - 0.002 * BF13 + 6.444 * BF15 - 0.427 * BF1 + 68.109 \\ * BF19 \tag{4}$$

model CDS = BF1 BF2 BF3 BF4 BF5 BF7 BF9 BF11 BF13 BF15 BF17 BF19.

4.5. Analysis results & discussion

According to the analysis results, the most significant variables are BIST100 index (importance: 100), VIX index (importance: 79.567), MSCI Turkey index (importance: 43.033), and USD/TL FER (importance: 35.847), respectively for the period which is before Covid-19 pandemic times. On the other hand, the most significant variables are MSCI emerging market index (importance: 100), number of new deaths from Covid-19 (importance: 91.866), USD/TL FER (importance: 63.669), WACF (importance: 43.247), number new cases from Covid-19 (importance: 30.813), and VIX index (importance: 10.088), respectively in Covid-19 pandemic times.

The analysis results reveal that Turkey's sovereign CDS spreads are mainly affected from USD/TL FER, VIX index, and MSCI index (MSCI Turkey index and emerging market index) in the both period. Also, 2 Covid-19 situation (number of new cases and deaths) are determined as influential factors in Covid-19 times. On the other hand, number of cumulative cases, number of cumulative deaths and measures do not have effect on Turkey's CDS spreads in any period examined which is quite surprising since it was expected that they would have effect.

Based on the analysis results, it can be mainly recommended that the critical barriers in each variable should be exceed. For example, 109.6 thousand is critical barrier for BIST100, TL 6.15 is important for USD/TL FER before Covid-19 pandemic. On the other hand, TL 6.5 is important for USD/TL FER, 311 is important for number of new cases, and 59is significant number of new deaths on each day in Covid-19 pandemic times. By considering that Turkey has been in Covid-19 pandemic times, and Turkey does not have the capacity to lower the negative effects of global factors, Turkey should focus on the national variables which are USD/TL FER, BIST100 index, WACF, and number of new cases and deaths resulting from Covid-19 pandemic. Especially, USD/TL FER is so important for Turkey's CDS by taking into consideration that there are quite high amount of foreign exchange denominated debts. Turkey could prevent the negative contagion effect of FER through keeping USD/TL FER under control.

Moreover, other polices, besides the points mentioned above, could be applied by regulatory authorities in Turkey. An important point is that there are interactions between variables and this condition should be considered in developing polies. For this reason, possible outcomes of the precautions on CDS spreads must be foreseen before implementation.

5. Conclusion

The study examines the behavior of Turkey's sovereign CDS spreads before and in time of Covid-19 pandemic. Because, emerging countries need foreign financing, foreign portfolio investments are significant for emerging countries, CDS spreads are important credit default indicator, and there is Covid-19 pandemic over the world including Turkey. In this context, 5-years CDS spread is used as dependent variable; 6 (3 global, 6 macroeconomic) indicators are selected by benefitting from the studies present in the literature; 6 Covid-19 situations are added to the analysis; and daily data between 12.06.2019 and 06.16.2020 is analyzed with using MARS method, which provides the high predictive accuracy of the results.

As a result of MARS analysis, it is defined that the most influential factors vary according to period whether Turkey has been in Covid-19 time or not. The results imply that Covid-19 pandemic causes the increasing effect on Turkey's CDS spreads. In addition, USD/TL FER, VIX index and some

MSCI indices are determined as influential in both period. On the other hand, some variables like number of cumulative cases, number of cumulative deaths, and measures do not have effect on Turkey's sovereign CDS spreads which were expected to have effect. Based on the results, some recommendations are presented in the study.

In the study, Turkey is examined because Turkey is 6th country which has the highest CDS spreads on the world. Also, Turkey's CDS spreads have increased in time of Covid-19 rapidly. Taking measures by considering the results of the study, which emphasize the importance of new cases and deaths number from Covid-19 pandemic on Turkey's CDS spreads, is quite significant. Hence, Turkey could increase foreign portfolio investment inflows to Turkey. Moreover, additional analysis for Turkey at the end of Covid-19 pandemic times could provide additional contributions to the literature, and new policy proposals could be recommended.

Including of a different bundle of countries and including more emerging countries like Venezuela, Argentina, Pakistan, Egypt, Ukraine, South Africa, Brazil, Italy, Greece, and Mexico which have highest CDS spread on the world as of 05.10.2020 or emerging country groups like BRICS-T, Fragile Five, MINT, and E7 could be beneficial in terms of extending current literature. Moreover, new variables could be included in analysis and new statistical and econometric methods could be applied in the forthcoming studies.

Conflict of interest

There is no conflict of interest to be disclosed.

References

Akçelik F, Fendoğlu S (2019) Country Risk Premium and Domestic Macroeconomic Fundamentals When Global Risk Appetite Slides. CBRT Research and Monetary Policy Department, No. 2019-04.

Alexander C, Kaeck A (2008) Regime Dependent Determinants of Credit Default Swap Spreads. *J Bank Financ* 32: 1008–1021.

Benbouzid N, Mallick SK, Sousa RM (2017) An International Forensic Perspective of the Determinants of Bank CDS Spreads. *J Financ Stability* 33: 60–70.

CBRT (2020a) Inflation Report 2020-I. Available from: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Reports/Inflation+Report.

CBRT (2020b) Electronic Data Distribution System (EVDS). Available from: https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket.

Cremers KM, Driessen J, Maenhout P (2008) Explaining the Level of Credit Spreads: Option-Implied Jump Risk Premia in a Firm Value Model. *Rev Financ Stud* 21: 2209–2242.

Dooley M, Hutchison M (2009) Transmission of the US Subprime Crisis to Emerging Markets: Evidence on the Decoupling-Recoupling Hypothesis. *J Int Money Financ* 28: 1331–1349.

Ertuğrul HM, Öztürk H (2013) The Drivers of Credit Swap Prices: Evidence from Selected Emerging Market Countries. *Emerging Markets Financ Trade* 49: 228–249.

Fontana A, Scheicher M (2016) An Analysis of Euro Area Sovereign CDS and Their Relation with Government Bonds. *J Bank Financ* 62: 126–140.

Friedman J (1991) Multivariate Adaptive Regression Splines. *Annals Stat* 19: 1–141.

Galil K, Shapir OM, Amiram D, et al. (2014) The Determinants of CDS Spreads. *J Bank Financ* 41: 271–282.

Galil K, Soffer G (2011) Good News, Bad News and Rating Announcements: An Empirical Investigation. *J Bank Financ* 35: 3101–3119.

Goh ATC, Zhang Y, Zhang R, et al. (2017) Evaluating Stability of Underground Entry-Type Excavations Using Multivariate Adaptive Regression Splines and Logistic Regression. *Tunnelling Underground Space Tcehnology* 70: 148–154.

Hasan I, Liu L, Zhang G (2016) The Determinants of Global Bank Credit-Default-Swap Spreads. *J Financ Serv Res* 50: 275–309.

Hassan MK, Kayhan S, Bayat T (2017). Does Credit Default Swap Spread Affect the Value of the Turkish Lira Against the US Dollar? *Borsa İstanbul Rev* 17: 1–9.

Hastie T, Tibshirani R, Friedman J (2009) The Elements of Statistical Learning: Data Mining, Inference and Prediction. 2nd Edition. New York: Springer.

Hibbert AM, Pavlova I (2017) The Drivers of Sovereign CDS Spread Changes: Local versus Global Factors. *Financ Rev* 52: 435–457.

Johnson TC (2002) Rational Momentum Effects. *J Financ* 57: 585–608.

Kocsis Z, Monostori Z (2016) The Role of Country-Specific Fundamentals in Sovereign CDS Spreads: Eastern European Experiences. *Emerging Markets Rev* 27: 140–168.

Lahiani A, Hammoudeh S, Gupta R (2016) Linkages between Financial Sector CDS Spreads and Macroeconomic Influence in a Nonlinear Setting. *Int Rev Econ Financ* 43: 443–456.

Liu LX, Zhang L (2008) Momentum Profits, Factor Pricing, and Macroeconomic Risk. *Rev Financ Stud* 21: 2417–2448.

Morgan Stanley (2020) EEMEA Covid-19 Impact & Response, Research Report.

Orhan A, Kırıkkaleli D, Ayhan F (2019) Analysis of Wavelet Coherence: Service Sector Index and Economic Growth in an Emerging Market. *Sustainability* 11: 6684.

Sagi JS, Seasholes MS (2007) Firm-Specific Attributes and the Cross-Section of Momentum. *J Financ Econ* 84: 389–434.

Shahzad SJH, Nor SM, Ferrer R, et al. (2017) Asymmetric Determinants of CDS Spreads: US Industry-Level Evidence through the NARDL Approach. *Econ Model* 60: 211–230.

Turkey Ministry of Health (2020) Covid-19 Numbers. Available from: https://covid19.saglik.gov.tr.

World Health Organization (2020) Covid-19 Numbers. Available from: https://covid19.who.int.

Yang L, Yang L, Hamori S (2018) Determinants of Dependence Structures of Sovereign Credit Default Swap Spreads between G7 and BRICS Countries. *Int Rev Financ Anal* 59: 19–34.

Zhang BY, Zhou H, Zhu H (2009) Explaining Credit Default Swap Spreads with the Equity Volatility and Jump Risks of Individual Firms. *Rev Financ Stud* 22: 5099–5131.