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REGIME SWITCHING DETERMINANTS OF SOVEREIGN CDS SPREADS: EVIDENCE FROM TURKEY

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Abstract

In this study, it is assessed the main determinants of sovereign CDS spreads in Turkey from January 2006 to December 2015. Before delving into the nonlinear Markov regime-switching model estimation, a conventional one-state linear model is estimated answering to what extent the sovereign credit risk is affected in between global and country-specific market variables and by credit ratings announcement changes. In broad strokes, the regime-switching analysis reveals that among domestic variables, it is the foreign exchange rate that affects the sovereign credit risk more in more volatile periods and among global variables, the indicators standing for global volatility risk premiums and international liquidity primarily influence the changes in the sovereign CDS spread in turbulent regimes whereas proxies for global risk free rate are significant more in tranquil regimes.

Keywords: Sovereign CDS Spread, Markov Regime-Switching, Turkey

JEL Classifications: G10, G22, G24

1. Introduction

Distinguishing the main determinants of risks in the credit market is of importance for policy stance in economies vulnerable to the risks coming out of financial markets, so that the domestic country could protect its public and private participants on thin ice from the global contagion or local factors. Defining the credit risk, among other indicators, credit default swap (CDS, henceforth) contracts written up for both sovereign and corporate bonds are highly utilized. Those contracts are analogous to insurance, so that in exchange for contingent payment to the seller, those contracts provide protection to buyers from losses that may be incurred on a credit event (International Monetary Fund, 2013). In the case of sovereign CDS market, as stated by Pan and Singleton (2008, p. 2346), the newly emerging market for sovereign CDS contracts presents an almost unique window for understanding “investors’ risk-neutral probabilities of major credit events impinging on sovereign issuers, and their risk-neutral losses of principal in the event of a restructuring or repudiation of external debts”. Thus, it paves the way for pricing overall country-specific credit risk where the premiums paid for the sake of protection from default are the indicators of credit risk as well.

Considering the gross notional amounts outstanding, it is seen that Turkey comes one of the leading countries in respect to debt related market size necessitating near at hand a deeper understanding of sovereign credit risk. Acknowledging the low possibility of credit event i.e., sovereign default for Turkey, corporate CDS yields or bond prices are not chosen in this study given that the corporate bond market in Turkey is less developed in volume and variety and is less liquid. In this regard, the sovereign CDS contract yields are rather preferred to count for the overall credit worthiness for the credit market in Turkey. Besides, in explaining sovereign CDS spreads, it is not straightforward to give identifying parsimonious sets of variables that are main candidates which are to a large extent provided for corporate CDS contracts (Doshi *et al.* 2014). In this study, the primary attempt is to reveal regime dependent determinants of the sovereign CDS spreads for Turkey. The sample period is from January 2006 to December 2015. Before delving into the nonlinear Markov regime-switching model estimation, as common in conventional studies on the determinants of C

DS spreads, a (one-state) linear model is used answering to what extent those spreads are affected in between global and country-specific market factors as well as credit ratings announcement. Then, it is allowed for those factors to behave differently in turbulent and tranquil states in affecting sovereign CDS spreads.

The paper is organized as follows. Section 2 provides a literature review regarding the studies on determinants of CDS spreads in both conventional and regime-switching models. Section 3 introduces the data and methodology. Then, in Section 4, the results for linear and Markov-regime switching models are given. Section 5 concludes.

2. Literature Review

Decisions of the financial market participants are directly influenced by the very nature of the sovereign credit risk diversifying the risks of global debt portfolios and determine the capital flow-costs across countries (Longstaff *et al.* 2011). A common measure of overall credit risk used in the literature is the return on the sovereign credit default swaps yields. Those sovereign CDS contracts constitute a growing part of the overall CDS market. Those sovereign CDS contracts are analogous to insurance. That is, in exchange for contingent payment to the seller, those contracts provide protection to buyers from losses that may be incurred on sovereign debt due to certain specified credit events which include failure to pay interest or principal on, and restructuring of obligations issued by the sovereign (International Monetary Fund, 2013). In a sovereign CDS contract, a spread of e.g., 50 basis points (bps) mean that the buyer of the credit protection must pay the annual amount of contingent payment to the seller equal to 0.5% of the notional value of the debt (Qian *et al.* 2016). The sovereign CDS spreads act as a proxy for investors' expectations on countries' sovereign credit risk and corresponding risk pricing. Note that the credit market risk is more identified with the sovereign CDS market compared to associated sovereign bond market (Duffie, 1999) since the former is taken as more liquid generating more accurate estimates of the pricing of the risk. It is highly acknowledged that the sovereign CDS spreads are on the crest of a wave in reflecting the macroeconomic fundamentals. Besides, sovereign CDS can provide "a useful hedge to offset sovereign credit risk and can thereby enhance financial stability" (International Monetary Fund, 2013, p. 58). Thus, those sovereign CDS spreads giving information in themselves regarding the cost of protection from default make information on overall credit market worthiness available to the all financial agents as well. However, it is still not so easy to draw clear-cut conclusions regarding which set of determinants belonging e.g., macroeconomic fundamentals, market-based variables, global or local factors, has a priori role in variations CDS yields. Note that in the literature instead of utilizing directly the data on macroeconomic fundamentals e.g., of external debt, trade openness, inflation, per capita GDP and economic growth as in Aizenman *et al.* (2013), it is mostly used some set of financial indicators to represent the real macroeconomic activity acknowledging that the agents in the financial sector are forward looking agents and that utilization of financial indicator allows using higher frequency data compared to macroeconomic data. Note also that as stated by Doshi *et al.* (2014), it is not straightforward to provide identifying parsimonious sets of variables that are main candidates in explanation of sovereign CDS spreads as opposed to the articulation in the literature for corporate CDS contracts. This in turn branches out studies on sovereign credit risk into distinct conclusions regarding relative importance of determinants for the CDS spread changes. Considering the literature on the conventional single-regime models on the main determinants of CDS spreads, it is seen that the conclusions change to a great extent across countries and over time. Besides, in bourgeoning regime switching models through which the determinants of the CDS spreads are allowed to change in accordance with different regimes the indistinctiveness is ever higher.

In the literature, two strands arise in their approach to the analysis of sovereign CDS spreads. On the one side, the overall credit risk is represented with the reduced form models. Through those models (for example, Pan and Singleton, 2008 and Longstaff *et al.,* 2011), the default intensity is specified depending on a number of latent factors or state variables (Doshi *et al.* 2014). By using the maximum likelihood estimates and applying their model to Mexico, Turkey, and Korea, countries with different geopolitical characteristics and credit ratings, Pan and Singleton (2008) show that there are systematic and priced risks associated with unpredictable future variation in the arrival rates of credit events implicit in the term structure of sovereign CDS spreads and that credit spreads for all three countries do have a strong common relation with US stock market volatility approximated by the VIX index. Longstaff *et al.* (2011) contribute to Pan and Singleton (2008) by applying their model to a larger sovereign sample and a much broader set of variables and find that the most significant variables for CDS credit spreads are the US stock and high-yield markets as well as the volatility risk premium embedded in the VIX index. In Augustin (2012), a recursive preference-based model is developed to study the term structure of CDS spreads and see the relative importance of global and country-specific risk factors in determination of the dynamics of sovereign credit risk.

On the other side, sovereign CDS spreads are incorporated into regression analysis in order for revealing chief macroeconomic and financial determinants of credit risk. As stated by Doshi *et al.* (2014) the winning edge of this approach compared to reduced-form models is giving more intuition on relative significance across particular determinants of sovereign default. Considering the literature on the conventional single-regime models, among others, Dieckmann and Plank (2012) study the determinants of the price of insurance against default of European sovereign CDS market and show that a deteriorating state of the financial sector comes up with a larger CDS spread and that both local and global shocks gain importance in explaining CDS spreads in the post-crisis episode. In the related literature, global and regional determinants are more emphasized in explaining sovereign credit worthiness than by country-specific risk factors (e.g., Fender *et al.* 2012; Fontana and Scheicher, 2010). Others besides, argue for a robust link between credit rating announcements made by leading agencies and CDS spreads, so that the rating announcements bringing new information together do have spillover effects on the CDS spreads (Ismailescu and Kazemi, 2010; Made and Olszamowski, 2008). Micu *et al.* (2006) provide evidence over an event study that all types of rating announcements i.e., outlooks, reviews and rating changes, whether positive or negative, generate significant effects on CDS prices and contain pricing-relevant information whereas in Hull *et al.* (2004) found that the positive rating events are much less significant than negative rating events in their effects on CDS yields.

There is a very limited number of study for understanding overall Turkish sovereign credit risk in the related literature. Ozkaplan (2011) analyzed whether there is a relationship between Turkish sovereign CDS and certain financial indicators as of Eurobond, Dow Jones Index and bonds. The study reveals a low positive correlation between foreign exchange rate and CDS spread, significant relation between Eurobond, Dow Jones Index and CDS spreads. Besides, it is found for high relevance of CDS spreads with underlying Turkish government bonds. Oner Kaya *et al.* (2015) investigated the effects of sovereign credit ratings on CDS spreads for Turkey with the method of event study and found that CDS spreads increase abnormally in the 7-day period preceding the date on which it was announced the downgrade of credit ratings or downward revisions in the sovereign's credit outlook and that announcements on upgrade of credit ratings or upward revisions in the sovereign's credit outlook did not alter dramatically CDS spreads.

The abovementioned studies grounded mostly on the single-regime assumption, however, are highly criticized in the default literature for their inability of detecting the regime-specific effects on sovereign CDS spread changes (Qian *et al*. 2016). Blommestein *et al.* (2016) show that the single regime specification and covariates exogeneity assumption may generate misleading results in the related literature. They found a notable switching from a tranquil regime to a turbulent regime in the sovereign CDS market of some set of European countries in the post-crisis episode. The Markov-regime switching model due to Hamilton (1989) is hereby highly utilized for the sake of obtaining the possible breaks in the economic time series. Among others, Alexander and Kaeck (2008) use Monte Carlo approach to test the null hypothesis of one regime against the alternative of two regimes and show that a Markov switching regression gives a better fit with the observed data than a linear regression model. One of the leading reasons for the regime-switching behavior of the CDS spreads is the financial contagion which takes place when the international spillovers from global financial markets to the domestic country get intensified in the turbulent periods (Qian *et al.* 2016). Thus, assuming for two states, the concomitant conclusion is that the impact on the sovereign CDS spread of the global indicators that is, the financial contagion, is relatively weaker in the tranquil periods (Qian *et al.* 2016). Instead of incorporating the sovereign credit risk in to the regime-switching model framework in the form of CDS spreads, Calice *et al.* (2015) define the CDS term premium (i.e., the slope of CDS credit curve) a difference between CDS spreads at two different maturities, specifically 5 and 10 years to generate a forward-looking measure of idiosyncratic sovereign credit risk as perceived by financial markets, so that they differentiate between the unobserved components and their short-term determinants. In those bourgeoning regime switching models, there are recently accumulated analyses on country specific cases for which the regime-specific determinants of sovereign CDS spreads are considered (Ofori, 2015; Qian and Luo, 2016).

3. Data and methodology

3.1. Data

In explanation of the changes in CDS spreads for the case of Turkey following the literature, we utilize two groups of explanatory variables: a set of global variables that include global financial market measures, liquidity indicators and risk of price measures; and country specific variables. The rating announcements provided by the rating agencies are also considered in the study to see whether some components of CDS spreads are identified by those announcements beside to the market prices acknowledging the criticisms on the quality of those ratings for accurately representing the overall credit worthiness in Turkey. In this study, following the literature, we use only the financial indicators to capture the real macroeconomic activities as well. The sample period is between 2006m1 and 2015m12. CDS yields at 5-year maturities are used to proxy for the overall sovereign credit worthiness. The monthly CDS spread data refers to the last trading day of the each month obtained from daily data.

In determining the variables that could have influence on the CDS spread among a very rich set, a priori place is given for market-related variables as proposed by the theory. In this study, we particularly follow Longstaff *et al.* (2011), Alexander and Kaeck (2008) and Fender *et al.* (2012) in determination of covariates:

Domestic covariates:

- *bist*: Changes in the BIST 100 stock index are used to capture the pricing behavior in the stock market.
- *fx*: The percentage changes in the FX rate of the local currency against U.S. dollar are included as explanatory variables for variations in the sovereign credit risk. The last trading day of the each month obtained from daily data is used.
- *reserv*: The monthly changes in the foreign currency reserves held domestically are counted as a proxy for the aggregate liquidity for the credit market.
- *bond*: The monthly changes in 1-year government bond yields are considered so as to see the effects of short term risk free rates for level. The last trading day of the each month obtained from daily data is used.
- *cdslag*: Controlling for how the change of the sovereign CDS spreads is persistent, first-order lagged value of CDS spread is considered given the non-existence of significant autocorrelation.
- *positivec, negativec*: Regarding inclusion of the effects coming out of credit rating announcements for sovereign bond issues, two dummies are constructed: one stands for the set of upgrade of credit ratings or upward revisions (positivec) and the other for downgrade of credit ratings or downward revisions in the sovereign (negativec).

In Figure 1 along with historical 5-year sovereign CDS yields, it is given the credit rate announcement changes, so that the upgrades of credit ratings are denoted by (++), upward revisions by (+) and downward revisions by (-).The announcements made by rating agencies of Moody's and Standard and Poor's (S&P) are distinguished in between in accordance with their changes compared to previous levels. Considering the period of 2006m1-2015m2, there has been *four* upgrades or upward revisions and *five* downgrades or downward revisions all of which juxtapose in between lower medium grade and highly speculative.

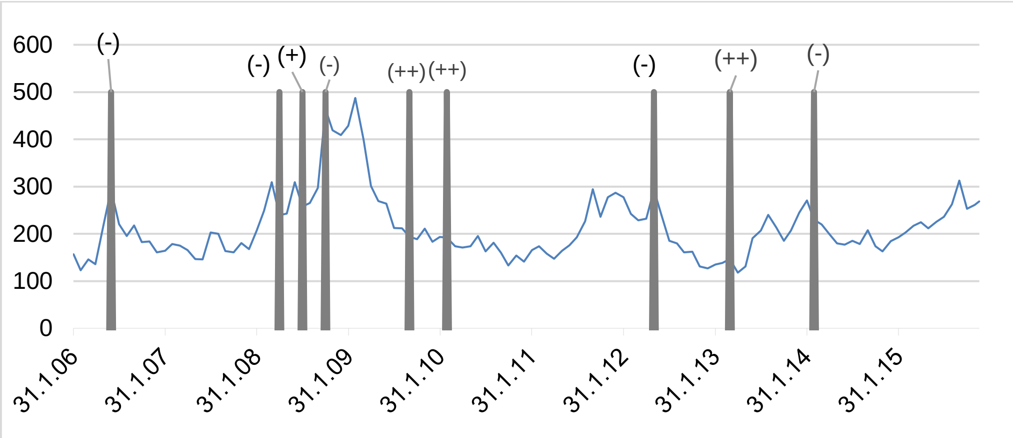

Figure 1. 5-year CDS Yields and Credit Rating Announcements

Global covariates:

- *treasury*: 5-yeary constant maturity treasury yields are chosen so as to indicate the risk-free rate for the level proxy.
- *tslope*: To meet the slope proxy, the difference between the long term (10-year) and short term (2-year) risk-free rate is calculated providing the instantaneous short rate.
- *tspread*: The treasury spread is contained for robustness check by dividing long term rate by the short one. For both slope and spread variables first differences are taken so as to make them stationary. In Alexander and Kaeck (2008), swap rates are advocated to stand for the unobservable risk-free interest rate but due to data-constraints we confine ourselves with the abovementioned proxies.
- *pe*: To stand for the variations in the equity risk premium, the monthly changes in the price-earnings ratio for S&P 500 index are used. Following Longstaff *et al.* (2011), the global risk premium is defined with two distinct proxies: equity risk premium and volatility risk premium.
- *vix*: To count for the volatility risk premium, the Chicago Board Options Exchange Volatility Index (VIX) that measures the market expectations on near term volatilities on option prices (30-days ahead volatility of S&P 500 index) is used. VIX arises as a measure of event risk (Pan and Singleton, 2008). Through VIX index, one can deduce the investors' sentiments and risk appetites such that as stated by Bhanot and Guo (2012) it can be taken as a proxy for capital availability of hedge fund investors.
- *vstoxx*: The monthly change in the Euro Stoxx 50 Volatility Index (VSTOXX) is used as another indicator of volatility risk premium.
- *libor*: To count for the international liquidity formation, one proxy for aggregate liquidity measure is change in the 6-month London Interbank Offered Rate (LIBOR). The argument is that funding shocks to the leveraged investors who hold sovereign debt may result in the declines in the market liquidity of securities and those externally arisen funding-related liquidity shocks probably have significant effects on the credit worthiness of the domestic credit spread. Note that first difference of LIBOR is taken so as to make it stationary.

- *liborspread*: As alternative to the libor, it is used the spread between 3-month LIBOR and 3-month treasury yield implying division the former by the latter.
- *eurocds*: It is also considered the effects of the regional sovereign CDS spreads on the domestic credit risk. As being the case for low-volatile credit markets, the average of the Europe CDS spreads for countries including Germany, Italy, Spain, France, UK and Belgium is used.

3.2. Methodology

In this section, before delving into the Markov regime-switching dynamic model, we firstly estimate the determinants of the Turkish CDS spreads using the linear regression model:

$$CDS_t = \beta_0 + \beta_1 index_t + \beta_2 fx_t + \beta_3 bond_t + \beta_4 reserv_t + \beta_5 pe_t + \beta_6 vix_t + \beta_7 libor_t + \beta_8 treasury_t + \beta_9 positivec_t + \beta_{10} negativec_t + \beta_{11} eurocds_t + \beta_{12} cds_{t-1} + \varepsilon_t. \quad (1)$$

To explore the regime specific determinants of the CDS spread, a Markov switching dynamic regression model is implemented with a high frequency data so as to see quick adjustment of the transition dynamics across unobserved states over which the regime dependent series may arise. Assuming that the state of the Turkish economy have experienced a very idiosyncratic nature of tranquil and turbulent states, it can be beneficial seeing the processes that may evolve differently in between different states that in turn reveal the regime-dependent series.

Markov-switching models due to seminal contributions in the literature particularly of Goldfeld and Quandt (1973) and Hamilton (1989) are the regime-switch models in which the transition between regimes occurs in accordance with an unobserved Markov chain process. Given the unobserved states e.g., state at time t s_t, the Markov-switching regression models give the state-dependent influence of explanatory variables (Piger, 2009). The parameters in linear regression parameters β_i are allowed to change in accordance with a transition probability in between those unobserved states featured by the nonlinear algorithm.

The methodological formation used here is taken from Hamilton (1994), Alexander and Kaeck (2008) and Avino and Nneji (2014). The Markov switching model allows the state of the economy to be in one of n regimes. The transition probability from state i at time t to state j at time $t+1$ is only affected by the state at time t, so that grounded on the Markov chain process effects of the previous states are precluded. Hence, the probability that $s_t = j \in (1, \dots, k)$ depends only on s_{t-1}, and given by

$$\mathbf{Prob}(s_t = j \mathrm{I} s_{t-1} = i, s_{t-2} = k, \dots) = \mathbf{Prob}(s_t = j \mathrm{I} s_{t-1} = i) = p_{ij}$$

Corresponding $k \times k$ transition matrix $\mathbf{P} = p_{ij}$ that shows all possible transitions from one state to the other is

$$\mathbf{P} = \begin{bmatrix} p_{11} & \cdots & p_{k1} \\ \vdots & \ddots & \vdots \\ p_{1k} & \cdots & p_{kk} \end{bmatrix}$$

The sum of each column is equal to 1 and all elements are nonnegative. Note however that in generation of the Markov chain process the probability $\mathbf{Pr}$, that $s_t = j$ depends not only the value at time s_{t-1} but also on a vector of the other observed series. The random $(N \times 1)$ vector Ψ_t is used to represent a Markov chain, so that the jth element of the vector is equal to one if $s_t = j$ and zero otherwise. The Markov chain is assumed to be unobservable, hence only the probabilities of being in one regime can be learned. If $s_t = i$, then the jth element of Ψ_{t+1} is a random variable that taking the value of unity with expected probability p_{ij} and zero otherwise.

The conditional expectation of Ψ_{t+1} given t is given as $\mathrm{E}(\Psi_{t+1}|\Psi_t) = \mathrm{E}(\Psi_{t+1|\mathrm{t}}) = \mathbf{P}\Psi_t$. The density of dependent variable conditional on the random variable s_t taking on the value j is

$$\upsilon_t = \mathrm{f}(\mathrm{y}_t|\mathrm{s}_t = j, \boldsymbol{x}_t, \boldsymbol{\varphi}_{t-1}, \boldsymbol{\theta}) = \frac{1}{\sqrt{2\pi\sigma_j^2}} \exp\left\{-\frac{(y_t - x_t'\boldsymbol{\beta}_j)^2}{2\sigma_j^2}\right\},$$

where $\boldsymbol{x}_t$ denote the vector stands for the explanatory variables, $\boldsymbol{\varphi}_{t-1} = (\mathrm{y}_{t-1}, \mathrm{y}_{t-2}, \dots, \mathbf{x}_{t-1}, \mathbf{x}_{t-2}, \dots)$ represent the information up to time $t-1$, $\boldsymbol{\theta} = (\mathbf{P}, \boldsymbol{\beta}_j, \sigma_j)$ is the vector of model parameters. Then, the joint density of y_t, s_t and s_{t-1} conditional on $\boldsymbol{\varphi}_{t-1}$ and $\boldsymbol{x}_t$ can be derived as

$$\mathrm{f}(\mathrm{y}_t, \mathrm{s}_t, \mathrm{s}_{t-1}|\boldsymbol{x}_t, \boldsymbol{\varphi}_{t-1}, \boldsymbol{\theta}) = \mathrm{f}(\mathrm{y}_t|\mathrm{s}_t, \mathrm{s}_{t-1}, \boldsymbol{x}_t, \boldsymbol{\varphi}_{t-1}, \boldsymbol{\theta}) \cdot \mathbf{Prob}(\mathrm{s}_t, \mathrm{s}_{t-1}|\boldsymbol{\varphi}_{t-1})$$

Let $P(\mathrm{s}_t = j|, \wp_t, \boldsymbol{\theta})$ denote the inference about the value of s_t based on the data $\wp_t$ containing all observations obtained through date t and on knowledge of the population parameters $\boldsymbol{\theta}$. This inference can be represented in the form of conditional probability by assigning the possibility that the nth observation is generated by the regime j. The conditional probabilities $P(\mathrm{s}_t = j|\wp_t, \boldsymbol{\theta})$ for j= (1,2,…,N) can be denoted by $\hat{\xi}_{\mathrm{t|t}}$. Then, the likeliness of the process to be in regime j in period $t+1$ given the observations obtained through date t can be denoted by the vector $\hat{\xi}_{\mathrm{t+1|t}}$ whose jth element represents $P(s_{t+1} = j|, \wp_t, \boldsymbol{\theta})$. The conditional state probabilities are obtained by recursively solving following pair of equations

$$\hat{\xi}_{\mathrm{t|t}} = \frac{\hat{\xi}_{\mathrm{t|t-1}} \odot \boldsymbol{v_t}}{1'(\hat{\xi}_{\mathrm{t|t-1}} \odot \boldsymbol{v_t})}$$

$$\hat{\xi}_{\mathrm{t+1|t}} = \mathbf{P}\hat{\xi}_{\mathrm{t|t}}$$

where **1** represents an $(N \times 1)$ vector of 1s, $\odot$ denotes element-by-element multiplication. The vector $\hat{\xi}_{\mathrm{t|t}}$ is the filtered probability being the best estimate for the Markov chaing given the all information up to time t. The values $\hat{\xi}_{\mathrm{t|t}}$ and $\hat{\xi}_{\mathrm{t+1|t}}$ are obtained for each date t given the starting values $\hat{\xi}_{\mathrm{t|0}}$ and the assumed value for $\boldsymbol{\theta}$. Iteration of the vectors $\hat{\xi}_{\mathrm{t|t}}$ and $\hat{\xi}_{\mathrm{t+1|t}}$ leads to the conditional log likelihood function $\mathcal{L}(\boldsymbol{\theta})$ for the observed data $\wp_t$ evaluated for $\boldsymbol{\theta}$:

$$\mathcal{L}(\boldsymbol{\theta}) = \sum_{t=1}^{T} \log f(\mathrm{y}_t|\mathrm{x}_t, \wp_{t-1}, \boldsymbol{\theta})$$

where $f(\mathrm{y}_t|\mathrm{x}_t, \wp_{t-1}, \boldsymbol{\theta}) = 1'(\hat{\xi}_{\mathrm{t|t-1}} \odot \boldsymbol{v_t})$. Markov switching regression is as follows:

$$CDS_t = \beta_{s_i,0} + \beta_{s_i,1} index_t + \beta_{s_i,2} fx_t + \beta_{s_i,3} bond_t + \beta_{s_i,4} reserv_t + \beta_{s_i,5} pe_t + \beta_{s_i,6} vix_t + \beta_{s_i,7} libor_t + \beta_{s_i,8} treasury_t + \beta_{s_i,9} eurocds_t + \beta_{s_i,10} cds_{t-1} + \beta_{11} positivec_t + \beta_{12} negativec_t + \varepsilon_{s_i,t} \quad (2)$$

where $s_i = j$, (j = 1,2). The equation (2) is similar to the equation (1) but now except for β_{11} and β_{12}, all the regression parameters are state-variant ones. The first-order Markov chain given the transition probability matrix ($\mathbf{P}$):

$$\mathbf{P} = \begin{bmatrix} \Pr(s_t = 1|s_{t-1} = 1) & \Pr(s_t = 2|s_{t-1} = 1) \\ \Pr(s_t = 1|s_{t-1} = 2) & \Pr(s_t = 2|s_{t-1} = 2) \end{bmatrix} = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}$$

where p_{ij} denote the transition probabilities from state i to j. In the light of above discussion, then the Markov regime-switch analysis for the expected changes in CDS spread $\Delta CDS_{t+1}^e = (\hat{\xi}_{1\mathrm{t}}\, \hat{\xi}_{2\mathrm{t}}) \begin{pmatrix} \hat{p}_{11} & 1-\hat{p}_{22} \\ 1-\hat{p}_{11} & \hat{p}_{22} \end{pmatrix} \begin{pmatrix} \hat{\mu}_1 \\ \hat{\mu}_2 \end{pmatrix}$ where $\hat{\mu}_1$ and $\hat{\mu}_2$ stand for the estimated mean changes in CDS spreads, $\hat{\xi}_{1\mathrm{t}}$ and $\hat{\xi}_{2\mathrm{t}}$ are the filtered probabilities for the regime 1 and regime 2, respectively. The multiplication of those filtered probabilities and transition probability matrix will give the estimate of probability satisfying state 1 and state 2 to hold at $t+1$. The expected changes in CDS spread is, then, obtained by this multiplication times the expected means.

4. Results

The existence / strength of autocorrelation in the linear regression model is controlled by the Cumby-Huizinga test statistic which is argued to be more efficient for testing autocorrelation at high orders and for the models containing weakly exogenous or endogenous regressors. Besides, through this testing, it is doable to take overlapping data and conditional heteroscedasticity into account. Given in Table 1, the null hypothesis that the time series is a moving average of known order zero is rejected but serial correlation presents at only first order and dies out after higher orders up to four.

Table 1. Cumby-Huizinga test for autocorrelation

lag	chi2	df	p-val
1	9.267	1	0.0023
2	0.193	1*	0.6608
3	0.066	1*	0.7976
4	0.183	1*	0.6685

Notes: Null: variable is MA process up to order 0; Alternative: serial correlation present at specified lags >0. * Eigenvalues adjusted to make matrix positive semidefinite actest.

The degree of serial correlation is tested by correlogram plot in Figure 2 through which one can deduce the serial correlations of residual versus its predetermined lags. The figure reveals that the correlations are very low and do not have any pattern. The gray areas in the figure are confidence limits and only for the first order lag it is found a low but significant autocorrelation across residuals.

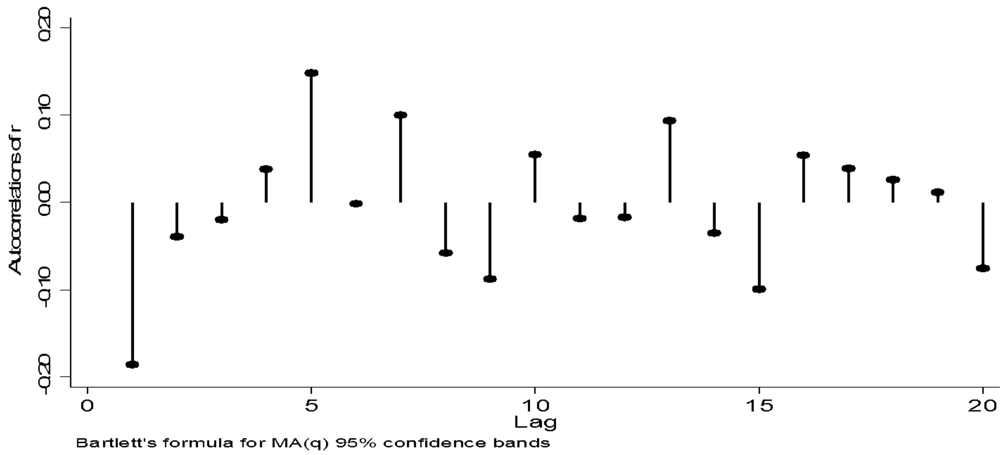

Figure 2. Correlogram for serial correlation

Controlling for the multi-collinearity, first, the correlation matrix for the sample period is considered as given in Table 2. From the table, it is revealed for high correlation among the change in CDS spread and the changes in stock market, in FX rate denominated in both U.S. dollar, in short-term government bond and European CDS. Considering the link between credit rating announcements and CDS spreads, the table provides that though there is not a high comovement between those two series the negative announcements still have a higher correlation with changes in CDS spread compared to positive announcements. In order for better capturing the existence of multi-collinearity, it is used the variance inflation factor (VIF) testing that reveals to what extent the variance of the coefficient estimated is inflated due to the problem of collinearity. When multicollinearity exists, then the standard errors and thus the variances of the estimated coefficients of interest are inflated by the variance inflation factor. Both VIF and 1/VIF (or the tolerance coefficient) provides that there is no collinearity among explanatory variables preventing the violation of the assumption of best linear unbiased estimator in linear regression (not reported).

Table 2. Correlation matrix for the period 2006m1 – 2015m12

	cds	index	fx	bond	reserv	pe	vix	libor	Tslope	positivec	negativec
cds	1.0000										
index	-0.6389	1.0000									
fx	0.7283	-0.6484	1.0000								
bond	0. 5621	-0.4190	0.4179	1.0000							
reserv	-0.2739	0.2809	-0.3134	-0.1863	1.0000						
pe	0.0194	-0.1249	0.1881	-0.0577	-0.1166	1.0000					
vix	0.4709	-0.3279	0.4168	0.1812	-0.1176	-0.0810	1.0000				
libor	0.0281	0.0397	-0.1410	0.2600	0.2192	-0.4746	0.0450	1.0000			
tslope	-0.1032	0.1107	-0.1900	-0.1607	0.1154	-0.1578	-0.0183	-0.0183	1.0000		
Positivec	-0.0758	0.1087	-0.0271	-0.0466	-0.0639	-0.2075	-0.1043	0.0042	-0.0033	1.0000	
negativec	0.1842	-0.1683	0.2455	0.1288	-0.2405	0.1320	0.0246	-0.0506	-0.1382	-0.0387	1.0000
eurocds	0.5286	-0.4901	0.4033	0.1781	-0.1746	0.1226	0.4383	-0.1362	-0.0221	0.0091	0.0621

Table 3 and 4 give the estimated transition probabilities and expected time durations for being in each state at time $t+1$, respectively. Hereby, following Kim and Nelson (1999) the expected duration of regime, $E(D_j)$ is calculated as

$$E(D_j) = \frac{1}{(1-p_{jj})}.$$

Table 3. Estimated Transition Probabilities for Model 5

Transition Prob.	Estimate	Std. Err.	95% Conf.	Interval
P11	0.3637	0.0975	0.2001	0.5664
P12	0.6362	0.0975	0.4335	0.7998
P21	0.2683	0.0628	0.1637	0.4072
P22	0.7316	0.0628	0.5927	0.8362

Table 4. Expected Duration Times for Model 5

Exp. Duration	Estimate	Std. Err.	95% Conf.	Interval
State 1	1.5718	0.2410	1.2502	2.3065
State 2	3.7260	0.8728	2.4554	6.1058

From the tables, it is revealed that the turbulent regime on the sample period for Turkey is more persistent since the probability of being in volatile state regardless of whether in the previous period the economy was in state 1 or state 2 and the time duration of staying in volatile state are overtly higher than in normal ones.

The overall results for the linear regression model controlling for the alternative explanatory variables are given in Table 5. In essence, for all specifications of the model, both the sets of global variables and country specific variables are included. Under almost all the specifications among domestic factors, the monthly changes in BIST 100 stock index (index), in the FX rate (fx) and in the one-year government bond yields (bond) rate do significantly affect the monthly changes in the CDS spread for Turkish economy. The directions of the effects are true to form, so that the price increases in the stock market do significantly reduce the CDS spread changes, whereas when the FX rate rises signaling for the domestic uncertainty buildup then the CDS spread increases as well. Besides, as an indicator of short-term risk free rate, the rise in the government bond yields also escalate the CDS spreads. Among others, it is the FX rate changes that prominently affect the CDS spread changes. One remarkable result is that the foreign currency reserves (reserv) which may serve as a proxy for the aggregate liquidity for domestic markets do not significantly affect the dependent variable changes.

Regarding the effects coming out of global market variables on CDS spread – and thus on overall credit risk –, Table 5 provides that in almost all model specifications, there seems the insignificance of the global market factors except for volatility risk premiums in determination of the changes in CDS spread which is very contrary to conclusions reached in the related literature (e.g., Fontana and Scheicher, 2010, Fender *et al.* 2012). Accordingly, in all models except for Model 10 it is seen that among global market factors it is only 30-days ahead volatility of S&P 500 index (vix) that significantly affects the changes in CDS spread for Turkey. Hence, it can be deduced that more volatile options increasing the capital for funding per unit of investment abroad results in the domestic credit risk to rise as well. Besides, as a robustness control, when we employ the Euro Stoxx 50 Volatility Index (vstoxx) as another proxy for the volatility risk premium it is seen that the significant effect on the CDS spread changes is still valid generating a slightly higher effect. Considering the other global factors that could have effect on credit worthiness in Turkey, it arises that none of the market variables has significant effects though the estimated coefficients have the expected signs. As opposed to the argument that funding shocks to the leveraged investors who hold sovereign debt –the rise in LIBOR rate can be counted as such shocks – may result in the declines in the market liquidity of securities and those funding-related liquidity shocks probably significantly affect the domestic credit spread (Brunnermeier, 2009), in all specifications of the model found that there seems no significant effect coming out of from the LIBOR rate changes (libor) or alternatively monthly changes in spread between 3-month LIBOR and 3-month treasury yield on CDS spread. In Models 9 and 10 the sovereign credit rating announcements for sovereign bond issues are incorporated into the model so as to see whether some components of CDS spreads are identified by those announcements beside to the market dynamics. As opposed to the highly pronounced robust effect on CDS spreads of those announcements in the literature (e.g., Micu *et al*. 2006; Hull *et al.* 2004), the estimated model reveals no significant effect on changes in CDS spread of credit rating changes. Still, it can be argued that the estimated coefficients are in expected signs, so that coefficient for positive credit rating announcements results in CDS yields to decrease and for negative announcements results in CDS yields to rise. Besides, the average of the Europe CDS spreads for countries does positively and significantly affect the domestic sovereign CDS spread.

Table 5. Results from Linear Regression Model Results

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
index	-0.516***	-0.524**	-0.374*	-0.410**	-0.384*	-0.342*	-0.349*	-0.385*	-0.380*	-0.171
	(0.194)	(0.212)	(0.205)	(0.194)	(0.206)	(0.194)	(0.185)	(0.205)	(0.210)	(0.223)
reserv	-0.271	-0.263	-0.138	-0.198	-0.181	-0.220	-0.181	-0.243	-0.248	-0.208
	(0.326)	(0.326)	(0.326)	(0.309)	(0.305)	(0.306)	(0.318)	(0.285)	(0.280)	(0.274)
fx	2.051***	2.035***	1.744***	1.753***	1.763***	1.742***	1.723***	1.759***	1.768***	1.785***
	(0.374)	(0.392)	(0.356)	(0.315)	(0.310)	(0.281)	(0.321)	(0.300)	(0.310)	(0.313)
bond			0.383***	0.368***	0.371***	0.340***	0.337***	0.380***	0.377***	0.394***
			(0.0978)	(0.0843)	(0.0866)	(0.0862)	(0.0959)	(0.0857)	(0.0877)	(0.0901)
pe	-0.0908	-0.0898	-0.0943	-0.0574	-0.0579	-0.0548	-0.0690	-0.0363	-0.0463	-0.0936
	(0.0921)	(0.0920)	(0.0833)	(0.0719)	(0.0682)	(0.0644)	(0.0794)	(0.0713)	(0.0794)	(0.0788)
vix	0.104*	0.105*	0.108*	0.110*	0.118*			0.112*	0.111*	0.0664
	(0.0602)	(0.0600)	(0.0596)	(0.0591)	(0.0618)			(0.0620)	(0.0620)	(0.0482)
libor	7.414	7.207	-0.163				1.245			
	(7.101)	(7.030)	(6.834)				(6.760)			
treasury		0.0149	-0.0437							
		(0.0756)	(0.0593)							
liborspread				-0.119	-0.138	-0.137		-0.126	-0.125	-0.127
				(0.133)	(0.125)	(0.114)		(0.123)	(0.119)	(0.104)
tslope				2.145			2.400			
				(4.575)			(4.287)			
tspread					-0.987	-0.793		-0.869	-0.857	-1.677
					(0.988)	(0.901)		(1.011)	(1.033)	(1.067)
vstoxx						0.168**	0.163**			
						(0.0683)	(0.0683)			
cdslag								-0.0607	-0.0591	-0.0473
								(0.0752)	(0.0683)	(0.0682)
positivec									-1.968	-4.396
									(3.799)	(3.566)
negativec									0.535	0.394
									(7.190)	(6.686)
eurocds										0.208***
										(0.0661)
Constant	0.718	0.717	0.426	1.179	1.284	1.237	0.374	1.341	1.383	1.009
	(0.975)	(0.976)	(0.937)	(1.203)	(1.214)	(1.180)	(0.910)	(1.199)	(1.159)	(1.055)
Observations	120	120	120	120	120	120	120	119	119	119
R-squared	0.621	0.621	0.670	0.674	0.676	0.688	0.682	0.679	0.679	0.714

Note: Standard errors in paranthesis. *, ** and *** represent 10%, 5% and 1% significance level respectively.

Table 6. Results from Markov Regime-Switching Model

VARIABLES	(State 1) Model 1	(State 2) Model 1	(State 1) Model 2	(State 2) Model 2	(State 1) Model 3	(State 2) Model 3
index	-0.407***	-0.275	-0.475***	-0.319	-0.946***	-0.298
	(0.115)	(0.194)	(0.132)	(0.213)	(0.139)	(0.204)
reserv	0.154	-1.414***	0.238	-2.188***	-0.610**	-0.868
	(0.197)	(0.548)	(0.231)	(0.657)	(0.300)	(0.581)
fx	1.312***	2.091***	1.768***	1.801***	0.391	2.227***
	(0.357)	(0.395)	(0.294)	(0.440)	(0.317)	(0.413)
pe	-0.401***	0.118	-0.0479	0.112	-0.187***	0.0358
	(0.0991)	(0.110)	(0.0963)	(0.121)	(0.0686)	(0.177)
vstoxx	0.165***	0.284***	0.136***	0.352***	0.139***	0.267***
	(0.0314)	(0.0697)	(0.0386)	(0.0806)	(0.0332)	(0.0784)
libor	-19.04***	35.27***	-16.88***	38.66***	-2.991	14.07*
	(3.720)	(7.931)	(4.440)	(7.966)	(3.973)	(8.329)
treasury			0.0688	0.0822	0.144***	0.0112
			(0.0549)	(0.101)	(0.0534)	(0.104)
cdslag					-.2815***	-0.244***
					(3.049)	(3.357)
eurocds					0.0761*	0.283
					(0.044)	(0.172)
Constant	-4.110***	4.140***	-3.269***	6.663***	0.413	2.608
	(0.845)	(1.432)	(0.923)	(1.689)	(0.893)	(2.282)
P11	0.0430		0.2504		0.3877	
	(0.149)		(0.585)		(0.234)	
P21	0.5424		0.7583		0.7922	
	(0.109)		(0.098)		(0.112)	
sigma1	3.6000		4.4810		3.9163	
	(0.785)		(0.585)		(0.834)	
sigma2	8.7684		8.5281		9.0495	
	(1.492)		(1.879)		(1.163)	
AIC	7.3620		7.3578		7.2676	
SBI	7.7801		7.8224		7.8281	
Observations	120		120		119	

Note: Standard errors in parentheses. *, ** and *** represent 10%, 5% and 1% significance level, respectively.

In the wake of linear regression model, we can reach for the nonce the preliminary results on the prominent determinants of sovereign CDS spreads but assuming for a very idiosyncratic nature of tranquil and turbulent states in the financial markets guaranteed by increments in the financial openness, it can be beneficial seeing the processes that may evolve differently in between different states. The argument is then that the magnitude of the influence of the changes in the explanatory factors does very depend on the state the market is in. In this regard, we consider different specifications of regime switching model in which there exist two states corresponding to more tranquil periods i.e., state 1 and to more turbulent periods i.e., state 2. In the model construction, all the explanatory variables except the dummy variables of credit rating announcements are assumed to be regime-dependent.

The estimation results are given in Table 6 and Table 7 which include estimated coefficients belonging six different specifications. The tables reveal that for all of the model specifications the conditional variance (sigma1) in state 1 is overtly less than that (sigma2) in state 2 which enable us to reach that state 1 corresponds to tranquil regime whereas state 2 to turbulent one.

Table 7. Results from Markov Regime-Switching Model – Extended Model

VARIABLES	(State 1) Model 4	(State 2) Model 4	(State 1) Model 5	(State 2) Model 5	(State 1) Model 6	(State 2) Model 6
index	-0.497***	-0.137	-0.585***	0.0555	-0.652***	0.230
	(0.0376)	(0.206)	(0.0281)	(0.229)	(0.00994)	(0.175)
fx	1.574***	2.025***	1.185***	2.576***	1.192***	2.182***
	(0.0856)	(0.419)	(0.0868)	(0.437)	(0.0230)	(0.342)
reserv	-0.569***	-0.765	-0.937***	-1.014*	-1.335***	-0.438
	(0.175)	(0.471)	(0.0925)	(0.517)	(0.0236)	(0.317)
pe	-0.284***	-0.0305	-0.202***	-0.00815	-0.195***	0.121
	(0.0401)	(0.126)	(0.0180)	(0.155)	(0.00441)	(0.145)
vstoxx	0.0653***	0.236***				
	(0.0115)	(0.0897)				
libor	-13.60***	21.83***	-10.69***	26.24***	-8.706***	14.85**
	(1.929)	(8.037)	(1.038)	(8.790)	(0.282)	(7.527)
treasury	-0.0554***	0.115				
	(0.0163)	(0.0844)				
cdslag	-0.232***	0.0245	-0.272***	-0.0111	-0.295***	-0.0139
	(0.0136)	(0.0746)	(0.0129)	(0.0778)	(0.00376)	(0.0581)
eurocds	0.138***	0.163*	0.210***	0.133	0.189***	0.149**
	(0.0135)	(0.0878)	(0.0140)	(0.0820)	(0.00408)	(0.0631)
positivec	-8.351***	-8.351***	-9.902***	-9.902***	-11.54***	-11.54***
	(1.288)	(1.288)	(0.907)	(0.907)	(0.263)	(0.263)
negativec	4.262***	4.262***	4.381***	4.381***	5.943***	5.943***
	(0.940)	(0.940)	(0.859)	(0.859)	(0.239)	(0.239)
vix			0.0520***	0.161**	0.0624***	0.145***
			(0.00714)	(0.0686)	(0.00212)	(0.0511)
tspread			-0.773***	-1.241	-1.009***	-1.714
			(0.222)	(1.584)	(0.105)	(1.054)
bond					-0.178***	0.458***
					(0.00902)	(0.0839)
Constant	-4.641***	2.602**	-4.787***	2.329*	-5.118***	0.738
	(0.424)	(1.308)	(0.296)	(1.304)	(0.0766)	(0.946)
P11	0.2775137		0.3637894		0.2694745	
	(0.187)		(0.097)		(0.098)	
P21	0.2926544		0.2683835		0.1838534	
	(0.064)		(0.062)		(0.429)	
sigma1	0.8216283		0.8675202		0.215454	
	(0.341)		(0.152)		(0.353)	
sigma2	9.073487		9.265153		7.88488	
	(1.719)		(0.732)		(1.578)	
AIC	7.1665		7.2053		6.8856	
SBIC	7.7737		7.8125		7.5396	
Observations	119		119		119	

Note: Standard errors in parentheses. *, ** and *** represent 10%, 5% and 1% significance level, respectively.

In Figure 3, it is given the predictions on the sovereign CDS spread changes obtained for both states i.e., state 1 standing for tranquil regime and state 2 for turbulent regime. Instead of a single weighted prediction as given in former figure, the predicted values for sovereign CDS spreads are given considering both normal and volatile regimes. The figure reveals that the predicted values of changes in sovereign CDS spreads are higher for the turbulent regime in the upper swings of the series, true to type. Hence, when sovereign CDS spreads are obtained for turbulent regimes it results the response of the spread changes to behave in a stronger manner compared to tranquil regimes.

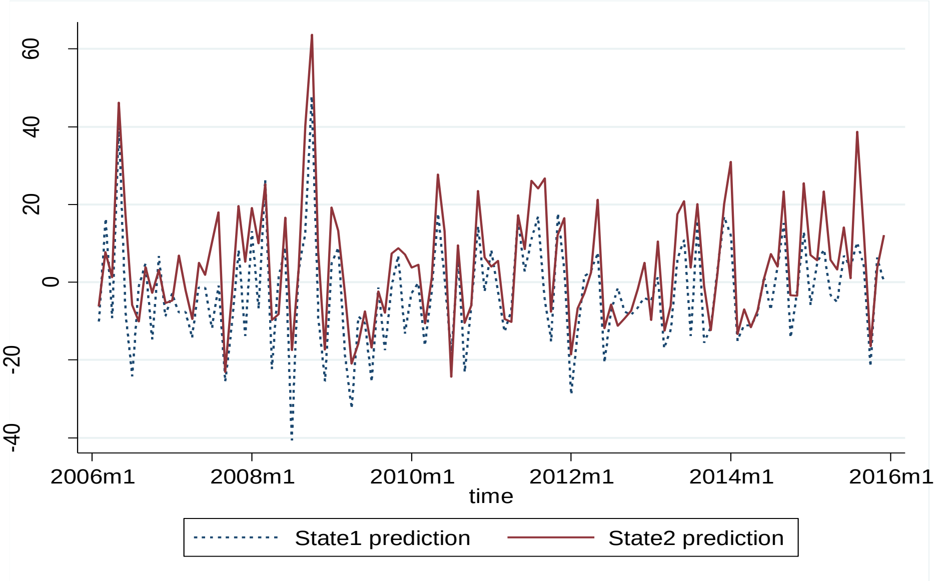

Figure 3. State-specific Predictions for Sovereign CDS Spread

Figure 4 represents the filtered probability of being in the turbulent regime along with the monthly changes in the sovereign CDS index. It is revealed from the figure that the switches in the probability of being in the volatile regime move together to a large extent with the sovereign CDS spread changes. Hence, true to form, as the volatility of those spread changes rises, the transition between tranquil and turbulent regimes become sharper. In the sample period, those sharp transitions are particularly apparent in the period from July 2007 to March 2009, Jun 2011 to August 2013.

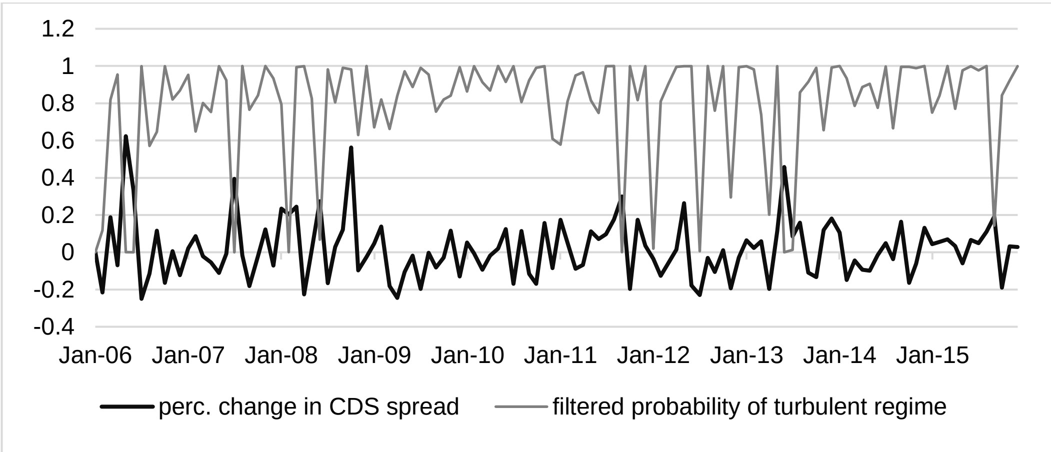

Figure 4. Turbulent Regime and changes in CDS spread

Regarding the model selection for all model specifications, it is revealed similar results grounded on the information criterion Akaike information criterion (AIC) and Schwartz Bayes information criterion (SBIC). The two state Markov regime-switching model estimates give that the Turkish lira-U.S. dollar exchange rate (fx) significantly affects the sovereign CDS spread changes prevailing for both turbulent and tranquil states. Still, the effect on the sovereign credit risk of FX rate changes is higher in more volatile periods, true to form, given the increasing overall vulnerability in the fragile episodes. Regarding the effect coming out of monthly changes in the BIST 100 stock index on the sovereign CDS spread for Turkish economy it is observed a difference in the significance of the effect in between two regimes. A regime switching behavior of the stock index seems to arise given that changes in index variable in normal periods have robust effects on the sovereign CDS spreads whereas in volatile periods there is not any significant effect prevailing for all model formations. Among other domestic factors, regarding the monthly changes in the foreign currency reserves treated as proxy for the aggregate liquidity for the credit market in Turkey, it arises a regime-switching process found particularly in Models 4, 5 and 6, so that in normal periods the changes in the foreign currency reserves do significantly and negatively affect the sovereign CDS spreads whereas in more volatile periods such significance vanishes. In Model 6, monthly changes in 1-year government bond yields are incorporated into the model for seeing the significance of short term risk free rates for the credit worthiness at different regimes. It is found for both regimes that there exists a robust link between risk free rates and sovereign CDS spreads as found for the single-regime case. Accordingly, the argument that good domestic macroeconomic conditions can reduce the investors' sentiments of the sovereign default or more precisely high credit risk can be more attributed to the tranquil periods and the effect is to a large extent insignificant in turbulent period.

Considering the effects coming out of the variations in the global equity risk premium for which the monthly changes in the price-earnings ratio for S&P 500 index are used, seen that though there arises a significant effect of price-earnings ratio on the sovereign credit risk in Turkey in the tranquil regimes, there seems no such robust effect in the turbulent regimes. Besides, though the estimated coefficient on the price-earnings ratio is small, still the direction of the effect is not true to type. In a similar vein, both the 5-year constant maturity treasury yields as the level and the treasury spread as the slope can be stated as the regime dependent such that they significantly and negatively explain the sovereign CDS spreads in the tranquil regimes whereas in the turbulent regimes the significant effect vanishes. Regarding the treasury spread variable corresponding to the division of the long term (10-year) by short term (2-year) risk-free rates, in the normal episodes seen that as the instantaneous short rate rises, then the sovereign CDS spread in Turkey falls around 1 bps. For analyzing financial contagion side of the global credit risk, we consider the average of the European Sovereign CDS spreads. It is revealed that though the European CDS spread changes significantly and positively influence the variations in sovereign CDS spreads for Turkey in tranquil regime, the significance of the effect is more of a veiled in the turbulent regime.

In explanation of the variations in the sovereign CDS spread in the turbulent regimes, the regime-switching analysis reveals that a priori place can be given to the indicators standing for global volatility risk premiums and international liquidity. Accordingly, VIX and VSTOXX indices deducing the investors' sentiments and risk appetites (Bhanot and Guo (2012) arise as significant and positive determinants of the changes in sovereign CDS premium for both tranquil and turbulent regimes. However, the mentioned effect is getting intensified in the latter. Considering the LIBOR rate used as a proxy for the funding-related liquidity shocks, there arises a regime-switching behavior such that though the significant effect prevails for both periods still the effect turns into positive in the turbulent period given the negative coefficient in the previous period.

It is also found that the preceding sovereign CDS spread does matter for the changes in CDS spreads but only prevailing for tranquil states. Herein, the interesting result is that the current CDS spreads is negatively influenced by their lagged values which can be attributed to low time duration of both states, so that there seems to arise expeditious transitions in between turbulent and tranquil episodes. Besides, in more volatile periods, the significance of the previous CDS values vanishes. Regarding inclusion of the effects coming out of credit rating announcements for sovereign bond issues into the regime-switching formation it is not assumed for regime-dependency for the credit rating announcement changes since given the time duration of each states is so short (Table 4) making the transition between two regimes too expeditious, it is difficult to attribute the credit rating announcements with nine changes in total to behave in accordance with the abstracts of each regime. Being very contrary to the linear regression estimates, when incorporated into the Markov regime-switching model, the credit rating announcement changes do significantly alter the sovereign CDS spreads. True to form, the upgrade of credit ratings or upward revisions reduces the sovereign credit risk whereas the downgrade of credit ratings or downward revisions increases the latter. Besides, the effect coming out of the positive announcements dominates that of negative announcements. Hence, such a conclusion is not in tune with Oner Kaya *et al.* (2015) who find that upgrades of credit ratings or upward revisions in the sovereign's credit outlook did not alter dramatically CDS spreads for Turkey.

5. Conclusion

In this paper, we study the determinants of sovereign CDS spreads in Turkey from January 2006 to December 2015. The primary attempt is to reveal regime dependent determinants of the sovereign CDS spreads for Turkey. The acknowledgement that the financial data with high frequency does behave in different manners in different states of economies which hold good for Turkey as well brings the arguments for deficiency of those conventional singe state models to capture overall effect on sovereign CDS spread changes of certain determinants. In this regard, we first reveal the prominent determinants of sovereign CDS spread changes in Turkey and then test whether the time series show a regime-switching behavior.

In our estimated one-state linear model found that under almost all the specifications the domestic financial indicators except for the foreign currency reserves significantly influence the monthly changes in the sovereign CDS spread where the directions of those effects are true to type. The foreign currency reserves, hereby, serving as a proxy for the aggregate liquidity for domestic markets do not significantly affect the sovereign credit risk changes. Besides, it is found for the insignificance of related global market indicators except for volatility risk premiums i.e., VIX and VSTOXX indices, in determination of the changes in CDS spread. When the credit rating announcements for sovereign bond issues are incorporated into the model to visualize whether some components of CDS spreads are identified by those announcements beside to the other market-related factors, it is observed for no significant effect on changes in CDS spread of those announcement changes.

Assuming for a very idiosyncratic nature of tranquil and turbulent states in the financial markets guaranteed e.g., by increments in the financial openness, it is tested the existence of processes that may behave differently in distinct states. More specifically, the argument is that the magnitude of the effect on sovereign CDS spreads of the changes in the financial indicators is not constant over time and does depend on the particular states the market is in. In order for seeing the state-dependent influence of explanatory variables we estimate a two-state Markov-switching model with different specifications. In broad strokes, it holds good for both global and local indicators to behave in a regime-switching behavior in their corresponding effect on the sovereign credit risk. Regarding the domestic variables, the effect on the sovereign credit risk of FX rate changes is higher in more volatile periods whereas that of domestic stock index and foreign currency reserves held domestically is more apparent in the normal periods. On the other hand, the estimates lay more emphasis on certain global financial market indicators i.e., indicators standing for global volatility risk premiums and international liquidity, in determination of the sovereign CDS spreads particularly in the turbulent states. Besides, the significance of financial contagion is justified in normal periods but becomes more of a veiled in more volatile periods. Lastly, as opposed to the linear regression estimates, when incorporated into the Markov regime-switching model found that the credit rating announcement changes do significantly alter the sovereign CDS spreads.

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