

Regime Switching Determinants of the Japanese Sovereign Credit Default Swaps Spreads

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Abstract—The paper analyses the determinants of the Japanese sovereign credit default swap spreads for the period 2004-2014 in a Markov regime switching framework. The paper employs a mix of both global and local factors in our analyses. The analyses reveal that, in both volatile and normal regimes, the global variables; the Implied volatility on the CBOE Index and the World interest rate variable proxied by the 10 year US treasury yields are highly significant. However, the default risk of the US is only significant in the normal regime. The local factors; the 10 year Japanese Government bond yield, the Leading index of the Composite Index of Japan and the Total Return on the Nikkei225 Index exhibit high degrees of significance in the volatile regime with the exception of the terms of trade variable. Only the Total Returns on the Nikkei 225 remain significant in the normal regime. Consistent with earlier studies, the impact and size of the variables are more pronounced in the volatile regime than the normal regime. These results not only emphasize the importance of nonlinear models in finance but also shed light on the factors influencing Japanese CDS spreads. The results are useful for researchers' and practitioners alike.

Index Terms—Japanese derivatives market, Markov switching models, non-linear models, sovereign credit default swaps.

I. INTRODUCTION

Credit default swaps continue to receive considerable research attention. Financial crises in the past decade has put Credit default swap (CDS) into a focus of attention. CDS is a derivative instrument where protection is bought on an underlying asset while making periodic payments to the seller and in return receives compensation in case of an event.

Existing literature (Benkert [1]; Breitenfellner and Wagner [2]; Cesare and Guazzarotti [3]; Doshi, Ericsson, Jacobs and Turnbull [4]; Ericsson, Jacobs and Oviedo [5]; Hull, Predescu and White [6]; Skinner, Timothy and Townend [7]) focused on the Corporate CDS or CDS Indices while exploring either its determinants, Valuation or the No-arbitrage relationship between Corporate CDS and bond market.

Nevertheless, the recent Euro area sovereign crisis has reignited the debate on the Sovereign credit default swap market. The increasing perceived risk and dramatic jumps in the Sovereign spreads during the crisis has necessitated the rapid research into the factors that drive those fluctuations. Several authors (Alper, Forni and Gerard [8]; Dieckmann and Plank [9]; Eyssell, Fung, and Zhang, G [10]; Fender, Hayo

and Neuenkirch [11]; Fontana and Scheicher [12]; Zinna [13]) have focused on understanding the Sovereign CDS market.

Despite this increasing shift to the Sovereign market, most of the literature is focused on the dynamics in the European area market and some few Emerging markets. The aim of this paper is to shift the discussion to the Japanese Sovereign CDS market and analyze its determinants in a Regime switching framework.

Our work is related to Pan and Singleton [14], who identify three important factors that are significant in explaining Japanese Sovereign Credit default Swap spreads in an Ordinary Least Square regression. However, this study differs, in that, we include other global and local variables in a Markov switching setting using monthly CDS spreads over a period spanning January 2004 to March, 2014. Specifically, what are the main drivers of Japanese CDS spreads and are these determinants regime dependent? The paper makes a number of significant contributions to existing literature. This is the first paper, to the best of our knowledge, which examines the Japanese Sovereign CDS Spreads in a Regime switching framework. Secondly, our sample period (2004-2014) is far longer than earlier studies. Also, we identify and use other local variables that have not been used in earlier studies on the determinants of Japanese Sovereign CDS. Lastly, we provide further insights into the Japanese CDS market where existing literature is scant.

Our main results indicate that determinants are indeed regime specific. Specifically, the global factors: the Implied Volatility on the CBOE and the 10year US Treasury yields remain highly significant in both the normal and volatile regimes while the default risk factor assume significance only in the normal regime .Also, the country specific factors; the Nikkei225 Total return Index, Leading index of Composite Index, the 10 year Japanese Government Bond Yield have more impact on the CDS spreads in the volatile regime than in the normal regime with the exception of the Terms of Trade variable which remains insignificant in both regimes.

The rest of the paper is structured as follows: Section II discusses the relevant literature; Section III discusses the data and methodology, Section IV covers the results and Section V covers the discussion and concludes under Section VI.

II. LITERATURE REVIEW

Several models employed on the studies into the determinants of CDS have focused on Ordinary least square regressions. Only until recently, has a handful tried to explore the regime dependent nature of these factors following the work of Hamilton [15].

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In particular, Guo and Newton [16] explore the impact of several factors, especially Liquidity, in a Markov Switching framework. They conclude that Leverage ratio, Volatility, Risk free rate and Liquidity are all important in explaining CDS spread changes and the effect of Liquidity is more pronounced in the crisis period than the normal period.

Also, applying a linear regression and a Markov Switching model to iTraxx Europe Indices, Alexander and Kaeck [17], find that the impact of the determinants is regime specific. Specifically, the impact of implied volatility is more sensitive to spread changes during volatile periods and Stock returns are more sensitive to spread changes during normal periods. More so, the explanatory power of the model is more pronounced during volatile period than tranquil periods.

Again, Huang and Hu [18] apply a Smooth transition Auto regressive model (STAR) to analyze the regime switching behavior of Corporate CDS spreads. Based on threshold estimates, they are able to identify precise dates of regime change. They further indicate that the determinants of CDS spreads are indeed regime specific.

Employing a Markov Switching Model, Chan and Marsden [19], using a set of firm level, economy wide and theoretical determinants on North American investment grade and high yield Credit default swap indices, make a number of important findings. First, during both volatile and tranquil periods, spreads have a positive relationship with the market wide default premium, VIX and Treasury bond yield, the underlying stock market returns and Fama-French's High-Minus-Low factor loading are all negatively related to the spreads. Also, they find that the determinants of CDS spreads are regime dependent.

Finally, Pan and Singleton [14], identify the Option Implied volatility Index for US equities (VIX), Zero Interest rate policy (ZIRP) and the Implied Volatility on the Nikkei Index Option (Nikkei IV) together explain about 65% of the Changes in Japanese Sovereign CDS spreads. They observe a positive relation for all variables with the spreads.

III. DATA AND METHODOLOGY

The sample period starts from January 2004 to March 2014 using monthly Japanese Sovereign Credit default swap (JCDS) data obtained from the Markit Database. This period covers and extends beyond the Global Financial Crisis and the Euro Crisis which facilitates our empirical work on examining the regime switching behavior of the determinants. Table I reports the descriptive statistics of the data. From the table, it could be noted that mean of the CDS spreads is around 44 bps with a standard deviation on average to be 39. Other descriptive statistics for the other seven variables are evident in Table I.

Monthly CDS data are obtained from daily data by taking the values of the last trading day of the month. We follow existing literature by using 5year spreads which have been shown to be the most liquid among the various maturities. In total, 123 observations for each of the variables are used in the regression. Fig. 1 shows a plot of the monthly 5year Sovereign CDS spreads for Japan .It could be observed that it shows sporadic increase during the time of the global financial crisis

(2007) and further peaks during the Great East Japan Earthquake beginning from March 2011 through to the European sovereign crisis. To account for the unit root in our data, the first difference of the logarithm of all the variables are used in our analysis.

TABLE I: OTHER DESCRIPTIVE STATISTICS FOR THE OTHER SEVEN VARIABLES

	Mean	Median	Minimum	Maximum	SD
JCDS	44.06	41.212	2.643	145.930	39.074
CompIndex	105.9	107.8	78.4	145.930	8.741
NikkeiReturns	15.35	13968	9510	22285	3541.741
JGBY	1.27	1.308	0.492	1.956	0.358
TOT	1.04	1.0179	0.8307	1.420	0.159
CBOE	20.08	17.08	10.42	59.89	9.106
IntRate	3.49	3.680	1.530	5.110	1.016
DefRisk	2.68	2.660	1.550	6.010	0.938

SD is the standard deviation; JCDS is the 5year Japanese Sovereign CDS; CompIndex is the leading index of the Composite Index of Japan; Nikkei Returns is the Total return on the Nikkei225 Index; JGBY is the yield on the 10year Japanese Government Bonds; TOT is the Terms of Trade; CBOE is the Implied Volatility on the CBOE; IntRate is the 10 year US Treasury rate; DefRisk is the difference between Moody's Corporate Baa and Aaa Bonds.

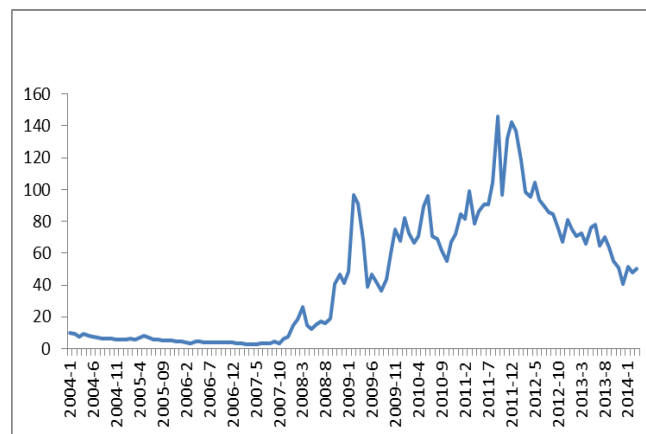


Fig. 1. A plot of the monthly 5-year Japanese sovereign CDS spreads obtained from the Markit Database. Data period spans from January, 2004 to March 2014.

This analysis employs several country specific and global factors in analyzing the spreads. First, we obtain several global factors that have already been employed in earlier studies. Our inclusion of global factors stem from the fact that the Japanese Sovereign CDS market is dominated by foreign investors (Shino and Takahashi, [20]) and also these variables have been established through earlier studies to have significant impact on markets worldwide. It includes, Chicago Board Options Volatility Index (VIX data), an implied volatility index, which has been established to be a global event risk factor (investor risk appetite) is downloaded from the Chicago Board of Exchange (CBOE) website, the 10year US Treasury rates is used as a proxy for World Interest rates and the difference between the Corporate bonds with Moody's rating of Baa and Aaa to proxy for US default yield spread. The latter two (2) monthly variables are downloaded

from the FRED series website and are in percentage points.

The analysis would be incomplete without the inclusion of country specific factors. Even though earlier results from Pan and Singleton [14] show that the Implied Volatility on the Nikkei Index has a potential impact on Japanese CDS spreads, we exclude it from our analysis due to its high correlation with the Implied Volatility on the CBOE. To cover for the state of the Japanese economy, we include the Nikkei 225 Total return index¹. The argument follows that a positive and expanding economy is an indicator of the ability of a country to repay its debt and should reflect in a lower default risk and a corresponding lower spreads for the country. Therefore, we expect a negative relationship between the Total Returns on the Nikkei225 Index and the CDS Spreads.

This paper includes the Leading Index of the Composite Index² (LCI) obtained from the website of Cabinet Office of Japan. These data provided on a monthly basis corresponds to the results of several surveys conducted on the overall business conditions in Japan. The leading Index anticipates changes in the direction of the economy. From the website, the Composite Index provides a quantitative measure of economic strength. The expectations of a positive signal in the economic strength of Japan should result in a reduction in the credit spreads. The argument follows that positive expectations in the economic strength of a country would result in a reduction in CDS spreads.

The yields on the Japanese Government 10 year Bonds are included in the analysis. The expectation is that an increase in yields should result in decrease in credit spreads.

As argued in Hilscher and Nosbusch [21], an increase in a country's terms of trade³ (TOT) is an indicator of an increase in exports over imports. With Japan been an export driven country, a positive terms of trade is both favorable to the local economy as well as sending a positive signal of the country's ability to repay its debt. Thus, an increase in the TOT variable should reduce its default risk and a reduction in credit spreads. This study employs the Markov regime switching methodology in analyzing the monthly first differenced logarithm of the 5 year Japanese Sovereign CDS Spreads (JCDS). The corresponding model is given as;

$$\begin{aligned} \Delta CDS_t = & \beta_{i,0} + \beta_{i,1} \Delta CompIndex_t + \\ & \beta_{i,2} \Delta NikkeiReturns_t + \beta_{i,3} \Delta JGBY_t + \\ & \beta_{i,4} \Delta TOT_t + \beta_{i,5} \Delta VIX + \beta_{i,6} \Delta IntRate_t + \\ & \beta_{i,7} \Delta DefRisk_t + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where $i \in \{1, 2\}$; CompIndex is the leading index of the Composite Index of Japan; Nikkei Returns is the Nikkei 225 Total Return Index, JGBY is the 10 year Japanese Government bond yields, TOT is the terms of trade variable; VIX is the Implied Volatility Index on the S&P 500, IntRate

is the 10 year US treasury Rates and the DefRisk is the difference between Moody's Corporate Baa and Aaa Bond yields.

IV. RESULTS

We run equation (1), allowing for the coefficient estimates for all the explanatory variables to vary. Table II presents the regression estimates and it significance levels. There is strong evidence that the global variables have a strong impact on the Japanese Sovereign CDS spreads. The Implied Volatility on the CBOE Index (VIX) exerts strong positive significance on Japanese Sovereign CDS spreads in both regimes.

TABLE II: RESULTS FROM THE REGIME SWITCHING MARKOV SWITCHING MODEL

Regime 1			
	Estimate	Std. Error	P-Values
(Intercept)	-0.006 (-0.546)	0.011	0.585
CompIndex	-1.018 (-1.949)	0.522	0.051
NikkeiReturns	-0.569* (-2.231)	0.255	0.026
JGBY	0.155 (1.243)	0.125	0.214
TOT	-0.006 (-0.007)	0.904	0.995
VIX	0.225** (3.147)	0.071	0.002
IntRate	0.399* (2.345)	0.170	0.019
DefRisk	0.986*** (4.928)	0.170	8.31e-07
Adj.R ²	0.52		
Regime 2			
	Estimate	Std. Error	P-Values
Intercept	0.139*** (5.236)	0.027	1.64e-07
CompIndex	-2.661* (-2.177)	1.222	0.029
NikkeiReturns	-2.548*** (-4.885)	0.522	1.03e-06
JGBY	-1.366*** (-4.307)	0.317	1.65e-05
TOT	-1.538 (-0.961)	1.600	0.337
VIX	1.088*** (6.302)	0.172	2.93e-10
IntRate	1.673*** (3.292)	0.508	0.001
DefRisk	0.602 (1.718)	0.351	0.086
Adj.R ²	0.89		

This table reports the results on the First differenced 5 year Japanese CDS spreads. The numbers in parenthesis represent the t-statistics. The data period covers for January 2004 to March 2014. The ***, **and * represents the 0.1percent; 1 percent and 5 percent significance levels respectively. Regime 1 and 2 are the normal and volatile periods respectively.

In the volatile regime, a percentage point increase in the VIX results in on average a 1.09 basis points (bps) increase in the spreads of the Japanese CDS. These are consistent with

¹ Data on the Nikkei225 Total Return Index is available on <http://indexes.nikkei.co.jp/en/nkave/index>

² Notes on the Composite Index is available on the Cabinet website at <http://www.esri.cao.go.jp/en/stat/di/di2e.html>

³ The Terms of Trade data is available on the Global Economic Monitor Database of the World Bank Database

earlier findings (as in Chan and Marsden [19]; Alexander and Kaeck [17]) who find a positive relationship between VIX and CDS Indexes. Though the VIX show a positive impact on CDS spreads in the less volatile regime, the significance reduces to a 1% level and magnitude of the coefficient

reduces as compared to the volatile regime. In effect, a percentage point increase in the VIX would lead to a 0.23bps increase in CDS spreads. This reaffirms existing findings of the importance of the VIX as a global factor that gauges investor risk.

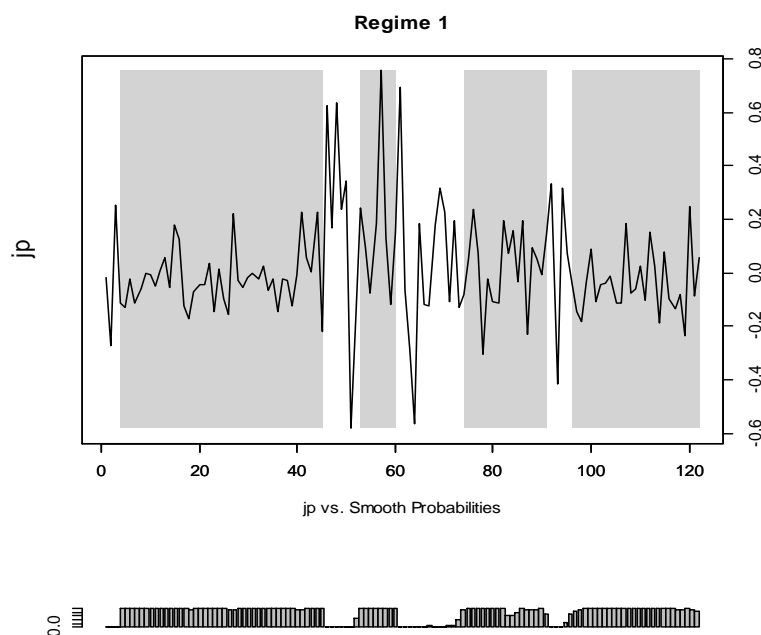


Fig. 2. Smoothed probabilities of the observations associated with the less volatile regime. The “jp” is the 5year Sovereign log first differenced CDS spreads.

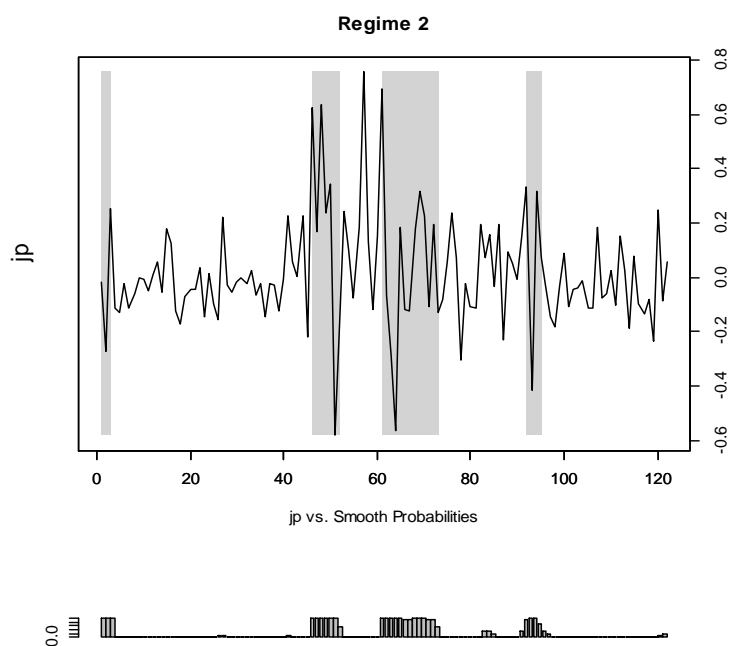


Fig. 3. Smoothed probabilities of the observations associated with the volatile regime. The “jp” is the 5year Sovereign log first differenced CDS spreads.

Existing research have mixed results on the expected sign for the Interest rate variable. In this research, the 10 year US Treasury Yield shows a positive sign which is consistent with those found by Arora and Cerisola [22]; Dailami *et al.* [23]; Hilscher and Nosbusch [21]. In the volatile regime, a percentage point increase in the interest rate will result in on average a corresponding 1.67 bps increase in CDS spreads. The magnitude of the coefficient is larger in the volatile period than in the less volatile regime. In that, a percentage point increase in Interest yield would result in on average a 0.40 bps increase in credit spreads in the normal regime. A

possible interpretation of the positive sign could be that, an increase in Interest yields signals a positive economic outlook in the USA. Thus, investors would demand a higher credit spread to compensate for the opportunity cost of investing in a foreign country.

Similarly, when default risk increases, we expect credit spreads to widen. Results show that in the normal regimes, the Default risk variable has a positive and highly significant impact on the Japanese Sovereign CDS spreads. In the volatile regime, despite showing a weak 10% significance, a percentage point increase in the default risk of the US would

on average result in a 0.60 bps increase in spreads. However, it shows a strong positive impact on credit spreads in the less volatile regime. In contrast to the other global variables; the size of the coefficient increases. Specifically, a percentage point increase would result in a 0.99bps increase in CDS spreads. A possible interpretation would be, in volatile regimes, investors are more concerned with the possible risk and default of the country they have invested in, Japan. Thus, they are less concerned with the default indicator in the US market. Above results indicate that the global factors are significant in varying range in both regimes, emphasizing the importance of these variables in explaining Japanese Sovereign CDS spreads.

Turning to the results from the local factors, the impact is more pronounced in the volatile regime than the normal regime. Considering that expectations play an important role in investor decisions. The Composite Index, an index constructed from a survey on economic sentiments should have an impact on credit spreads. An improvement in investor economic sentiments would result in a lower credit spreads. Specifically, in the normal period, a one percentage point increase in economic sentiment would reduce credit spreads by 1.02bps whereas in the volatile period it results in a 2.66bps decrease and the significance increases to a 1 percent level.

The Total Returns on the Nikkei225 Index is used to proxy the state of the Japanese economy. It assumes significance in both regimes and as other variables, the size of the coefficient is larger in the volatile regime than the normal regime. In effect, a percentage point increase in expectations of the state of the economy would result in a 0.57bps decrease in Sovereign spreads in the normal period. The magnitude of the coefficient increases in the volatile period where a percentage point increase in the Returns on the Nikkei225 Index would result in a 2.55bps reduction in CDS spreads with the significance increasing to a 0.1 percent.

Though, yields on Japanese Government Bonds historically remain low, during volatile periods it plays an important role in investor decisions. It remains insignificant in the normal regime. In the volatile regime a rise in the yields results in a reduction in the CDS spreads. Consistent with findings by Fender, Hayo and Neuenkirch [13] in other markets, who identify that an increase in the US 3-month treasury yields result in a decrease in CDS spreads. In this research, in the volatile regime, a percentage point increase in the Government yields would result in a 1.36 bps reduction in CDS spreads.

The Terms of Trade variable (TOT) exhibits a negative sign in both regimes. An indication that when the Terms of trade improves, Government would be able to repay its debt which inadvertently results in a lower credit spread. However, its impact remains insignificant in both regimes.

V. DISCUSSION

Our results are consistent with existing literature that have found strong evidence that the coefficients in the volatile regime tend to be higher than those in the normal regime (as in [16] and [17]). The statistical importance of our model is on average around 90% in the volatile regime as compared to a

52% explanatory power in the normal period. The important findings in both regimes could be interpreted from the established fact that, the Japanese CDS market is dominated by foreign investors. They therefore have a mix of both local and global factors that influence the premium. Thus, during both periods they tend to access and appraise their risk exposure by looking at the global variables with the exception of the default risk variable that assumes more significance in the normal regime than the volatile regime. During volatile periods (smoothed probability with this regime is as shown in Fig. 2) investor uncertainty sets in. Thus, it is no surprise that more variables become more highly significant in this period as compared to the normal period (Fig. 3).

VI. CONCLUSION

Sovereign credit default swaps has gained traction in the last decade, more or less, due to its perceived role in recent crisis. Studies on this instrument remain limited in comparison with other financial products especially in the Japanese Market. This study aimed to fulfil this void by analyzing its determinants in a regime switching framework. Appealing to several global factors that have been used in earlier studies and a host of local variables, the following conclusions are drawn:

First, the results suggest that the Japanese Sovereign CDS spreads are more influenced by global variables than country variables. They assume more significance in both regimes than the local factors. This is in line with established fact that the dominant investors' in the Japanese market are mostly foreigners.

Second, the results from the local variables indicate they are more influential in the volatile regime than the normal regime. This may be due to foreign investor uncertainty in the face of extreme markets volatility. Indicating that during volatile regimes, investors access and emphasize the importance of local factors in their investment decisions.

Finally, consistent with earlier studies, the impact and size of the variables are mostly more pronounced in the volatile regime than the normal regime.

In sum, determinants of the Japanese CDS spreads are regime specific and there should be more emphasis on the use of non-linear models in financial modelling.

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