AN ANALYSIS OF CDS RETURN VOLATILITIES: CASE OF BRICS

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Abstract- This paper considers the ability of the Generalized Asymmetric Power ARCH (APGARCH) model introduced by Ding, Granger and Engle (1993) to capture the stylized features of volatility in Credit Default Swap (CDS) returns for five countries (Brazil, Russia, China, South Africa and Turkey). We analyze these countries' daily CDS returns for the period January 27th, 2003 – November 4th, 2014. The results of this paper suggest that in the presence of asymmetric responses to innovations in the market, the APGARCH (1,1) Skewed Student-t model which accommodates both the skewness and the kurtosis of financial time series is preferred.

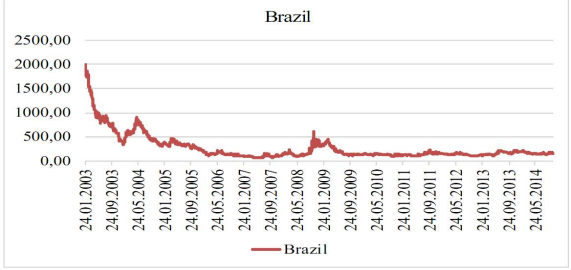
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I. INTRODUCTION

Credit default swaps (CDSs) are the most popular instrument in the rapidly-growing credit derivative markets. A CDS provides insurance against the default risk of a reference entity (usually a third party). The protection seller promises to buy the reference bond at its par value when a credit event (including bankruptcy, obligation acceleration, obligation default, failure of payment, repudiation or moratorium, or restructuring) occurs. In return, the protection buyer makes periodic payments to the seller until the maturity date of the CDS contract or until a credit event occurs. This periodic payment, which is usually expressed as a percentage (in basis points) of its notional value, is called CDS spread. Ideally, credit spread is a pure measure of the default risk of the reference entity.

CDS risk premiums have several advantages. First, CDS risk premium is a relatively pure pricing of default risk of the underlying entity. Second, Blanco et al. (2005) and Zhu (2004) show that, in the short run the CDS risk premiums tend to respond more quickly to changes in credit conditions. Finally, using CDS risk premium can avoid the confusion on which proxy to be used as risk-free rates, since they are already quoted as the differences above swap rates.

In the past decade, the credit derivatives market has experienced rapid growth, and the CDS has become the most widely traded instrument for transferring credit risk (Hull, 2008). However, increasing CDS risk premiums may be a sign that the financial investors put them in the same basket with the developed ones in terms of risk level (see Figure 1).



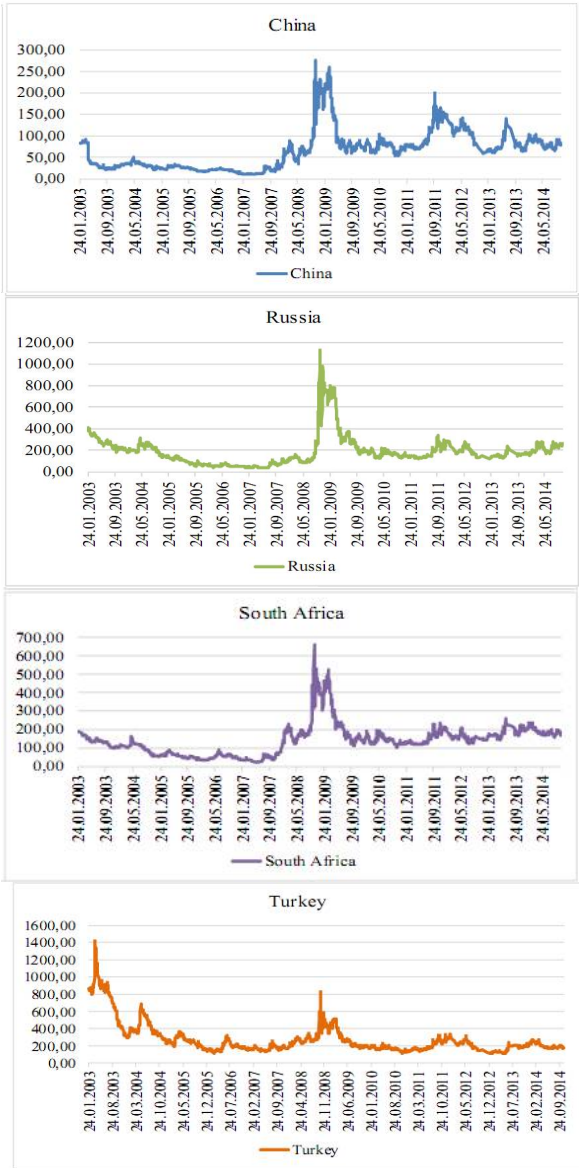


Figure 1: Credit Default Swap Index of Sovereign Issuers

The national and international economic, politic and/or social problems (shocks) affect especially the financial markets with high liquidity and increase the

volatility of these markets. In analyzed countries CDS premiums have seen remarkable increase in their values. These countries are considered as the driving force for GDP growth of the emerging economies. Having a big source of labor, natural resources and geopolitical importance these countries play an important role of global policies and influence the global economy.

There have been numerous developments in the ARCH literature to refine both the mean and variance equations, in order to better capture the stylized features of high frequency data. A common feature of the standard class of ARCH models is that they relate the conditional variance to lagged squared residuals and past variances. One recent development in the ARCH literature has focused on the power term by which the data is to be transformed. Ding, Granger and Engle (1993) introduced a new class of ARCH model called the Power ARCH model which estimates the optimal power term. They also found that the absolute returns and their power transformations have a highly significant long-term memory property as the returns are highly correlated.

Another important innovation has been the development of ARCH model specifications to describe the asymmetry present in financial data. Financial returns data commonly exhibits an asymmetry in that positive and negative shocks to the market do not bring forth equal responses. This phenomenon is most commonly attributed to the leverage effect (see Black 1976, Christie 1982 and Nelson 1991). The applicability of the Power ARCH class of model to stock market data has been well documented in papers such as Ding, Granger and Engle (1993), Hentschel (1995), Giot and Laurent (2004) and, Pan and Zhang (2006).

The purpose of this study is to assign the effect of the global crisis among the CDS return volatilities in Brazil, Russia, China, South Africa and Turkey. The remainder of this paper proceeds as follows. The section 2 details the general model and discusses how various ARCH models are nested within this APGARCH structure. The section 3 describes the CDS returns data to be used in this study and presents the empirical results. The robustness of these findings is assessed using the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and log-likelihood (LL) values. The section 4 contains some concluding remarks.

II. DATA AND EMPIRICAL RESULTS

The section shows the empirical results of models. The CDS returns of five countries are analyzed. Computations were performed with G@RCH 6.1 which is Ox package designed for the estimation of various time series models. The characteristics of the data are presented in the first subsection. The second subsection shows the estimated results of APGARCH (1,1) Skewed Student-t model specifications and the corresponding qualification tests. The APGARCH (1,1) model produced highly significant test statistics and contained either a significant asymmetry term or a power term which was significantly different from two.

3.1. Data

In this study, we used the Brazil, Russia, China, South Africa and Turkey's daily CDS returns; namely Brazil (BRA), Russia (RUS), China (CHN) and South Africa (SOA) and Turkey (TUR), for the period January 27th, 2003 – November 4th, 2014. These countries are considered as the driving force for GDP growth of the emerging economies. Having a big source of labor, natural resources and geopolitical importance these countries play an important role of global policies and influence the global economy. The CDS returns are calculated by log return $r_t = \ln(p_t / p_{t-1})$ of the closing values. The data used in the study is obtained from the Borsa İstanbul. Table 2 presents the descriptive statistics for each return series.

Table 2. Descriptive statistics

	BRA	RUS	CHN	SOA	TUR
Mean	-0.00088	-0.00015	-0.00002	-0.00003	-0.00056
Minimum	-0.39945	-0.28354	-0.63861	-0.26348	-0.23677
Maximum	0.35707	0.47361	0.54498	0.31178	0.38901
Standard Deviation	0.039615	0.04140	0.04866	0.03614	0.03555
Skewness	0.19817	-0.87170	0.015182	0.76489	0.68195
Excess Kurtosis	13.936	13.0660	32.9670	10.1390	10.3510
Jarque-Bera	23036.71	20587.22	128838.6	12465.28	12922.30
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ADF-Test (C, 0)*	-47.43	-47.54	-59.59	-48.12	-47.32

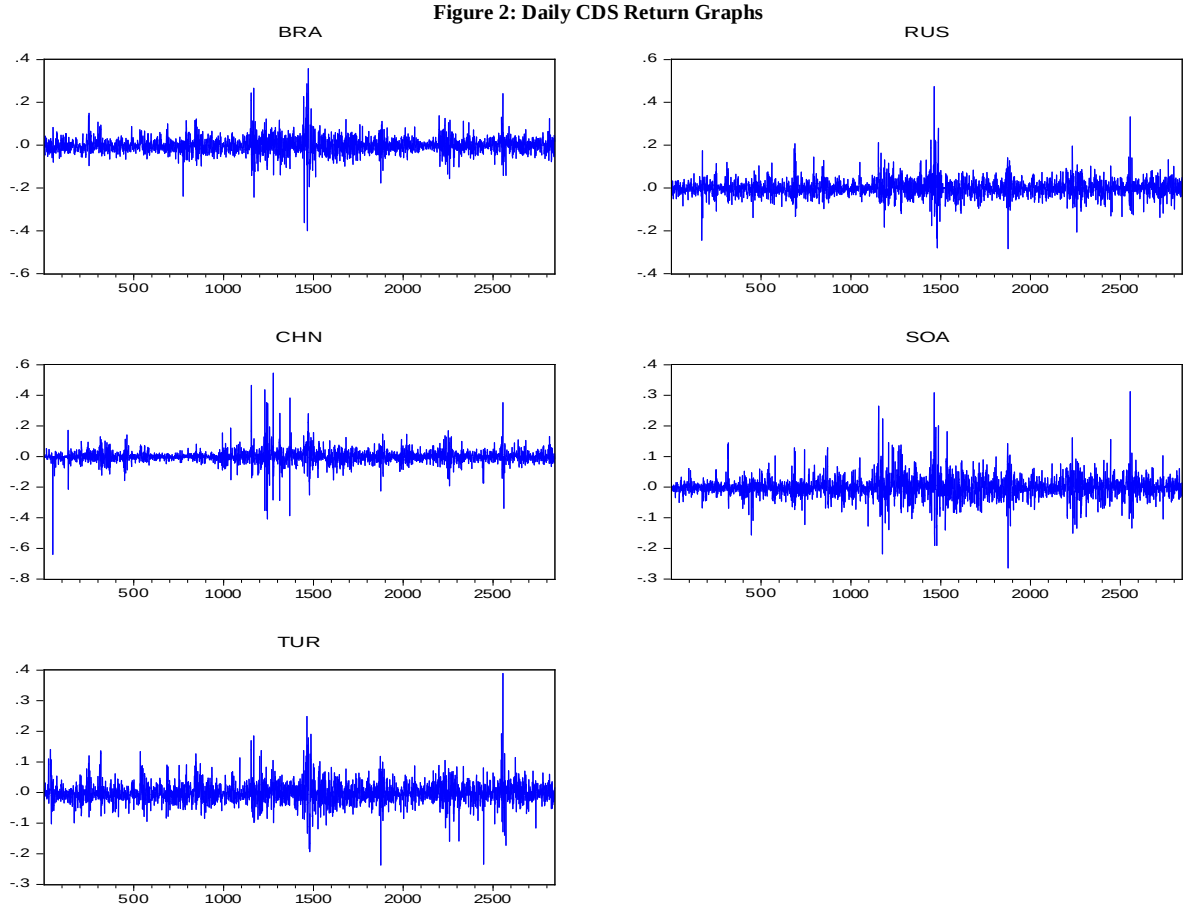
Notes: Brazil (BRA), Russia (RUS), China (CHN) and South Africa (SOA) and Turkey (TUR).

* (C, 0) indicates that there is a constant but no trend in the regression model with lag=0. All Augmented Dickey Fuller (ADF) test statistics reject the hypothesis of a Unit Root at the 1% level of confidence. MacKinnon critical value at the 1% confidence level is -3.44.

According to descriptive statistics, volatility, as measured by standard deviation is highest in CHN. The volatility range is between 0.04866 (CHN) and 0.03555 (TUR). It is not surprising that these series exhibit asymmetric and leptokurtic (fat tails) properties. All of the CDS return series have positive

skewness except RUS, and the kurtosis exceeds three indicating fat tails and leptokurtotic distribution. Thus, the return series of these CDS returns are not normally distributed. Additionally, by Jarque-Bera statistic and corresponding p-value we reject the null hypothesis that returns are well approximated by the normal distribution. For this reason, in this study we used the Skewed Student-t distribution, which takes into account fat tail problem and asymmetric structure. As well as descriptive statistics, examining the CDS return graphs in Figure 2 shows the volatility clustering in several periods especially in the global crisis period. Volatility clustering which means that there are periods of large absolute changes tend to cluster together followed by periods of relatively small absolute changes.

Figure 2: Daily CDS Return Graphs



3.2. Estimation Results

In this subsection, the APGARCH (1,1) model is estimated for each CDS return series under Normal, Student-t, GED (Generalized Error Distribution) and Skewed Student-t distributions. The standard of model selection is based on in-sample diagnosis including Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), log-likelihood (LL) values, and Ljung-Box Q and Q^2 statistics on standardized and squared standardized residuals respectively. Under every distribution, the model which has the lowest AIC and SIC or highest LL values and passes the Q-test simultaneously is adopted. In summary, ranking by AIC, SIC and LL favors the APGARCH (1,1) Skewed Student-t specification in all CDS return series except CHN (Student t).

Table 3 presents the results of this estimation procedure and from this table one can see that all of the ARCH and GARCH coefficients are statistically significant at the 1% level. Further, β_1 is close to 1 but significantly different from 1 for all series, which indicates a high degree of volatility persistence. β_1 takes values between 0.7908 (RUS) to 0.8874 (BRA) suggesting that there are substantial memory effects. Furthermore, in all cases the APGARCH models are stationary in the sense that V coefficient is lower than 1.

The APGARCH model includes a leverage term (γ) which allows positive and negative shocks of equal magnitude to elicit an unequal response from the market. Table 3 presents details of this leverage term and reveals that for all models fitted; the estimated coefficient was negative and statistically significant. This means that positive shocks lead to higher subsequent volatility than negative shocks (asymmetry in the conditional variance). Such a result was expected since response asymmetry is generally attributed solely to CDS data. The highest shock effects are occur respectively in TUR (-0.3551) and BRA (-0.2592).

Table 3. APGARCH (1,1) Skewed Student-t Model Estimation Results

	BRA	RUS	CHN	SOA	TUR
μ	-0.0018 [-3.234]	-0.0011 [-1.865[b]]	-0.0009 [-2.441[a]]	-0.0009 [-1.924[b]]	-0.0013 [-2.368[a]]
ω	0.0002 [1.239†]	0.0007 [1.385†]	0.0472 [1.896[b]]	0.0001 [1.724[b]]	0.0009 [1.322†]
α	0.1028 [6.965]	0.1911 [7.871]	0.2303 [4.871]	0.2040 [5.289]	0.1331 [6.931]
β	0.8874 [55.430]	0.7908 [33.670]	0.8107 [25.280]	0.8399 [29.420]	0.8402 [36.940]
γ	-0.2592 [-3.268]	-0.1843 [-3.149]	-0.1021 [-1.487]	-0.2007 [-2.746]	-0.3551 [-4.102]
δ	1.4403 [6.671]	1.3845 [6.457]	0.6986 [4.103]	1.0009 [5.845]	1.2111 [5.521]
ξ	0.0528 [2.049[a]]	0.0632 [2.5360]	-	0.0299 [1.454†]	0.0675 [2.575[a]]
υ	6.1155 [8.445]	4.4072 [11.521]	-	3.0658 [14.250]	4.5687 [11.530]
V	0.9768	0.9455	0.95976	0.9732	0.9478
LL	5,788.85	5,663.49	5,808.63	6,188.18	5,964.95
AIC	-4.0667	-3.9785	-4.0813	-4.3476	-4.1906
SIC	-4.0500	-3.9618	-4.0667	-4.3309	-4.1739
Q(20)	76.7149 (0.000)	60.6167 (0.000)	19.4642 (0.492)	48.3348 (0.000)	66.1447 (0.000)
Q^2(20)	21.4021 (0.260)	8.7960 (0.964)	0.2524 (1.000)	22.6849 (0.203)	18.2802 (0.437)
ARCH(5)	0.7976 (0.551)	0.6185 (0.686)	0.0029 (1.000)	0.4790 (0.792)	1.0907 (0.363)
P(60)	86.6588	88.8537	157.0633	262.8389	82.6068

Notes: Brazil (BRA), Russia (RUS), China (CHN) and South Africa (SOA) and Turkey (TUR).

a, b denotes 5% and 10% significance level respectively; † not significant; $V=\alpha_1 E\left(|z|-\gamma z\right)^{\delta}+\beta_1$ as a measure of volatility persistence, t-statistics of corresponding tests in brackets. LL is the value of the maximized log-likelihood, AIC-Akaike Information Criterion, SIC-Schwarz Information Criterion. Q(20) and Q^2(20) are the Ljung-Box statistics for remaining serial correlation in the standardized and squared standardized residuals respectively using 20 lags with p-values in parenthesis. ARCH(5) denotes the ARCH test statistic with lag 5. P(60) is the Pearson goodness-of-fit statistic for 60 cells.

From Table 3, the evidence of long memory process could be also found in the results of the model estimation because the power term (δ) of APGARCH models range in value from 0.6986 in the case of CHN to 1.4403 in the case of BRA. The average power term across all of the models estimated was 1.1471. For all models estimated the power term was significantly different from two. This means that for all models estimated, the optimal power term was some value other than unity or two which would seem to support the use of a model which allows the power term to be estimated. The APGARCH models the conditional variance for all CDS return series.

For the Skewed Student-t distribution, the asymmetric terms are negative (ξ > 0) and statistically significant for all CDS return series except SOA. Note that G@RCH does not estimate ξ but log(ξ) to facilitate inference about the null hypothesis of symmetry (since the Skewed Student-t equals the symmetric Student-t distribution when ξ =1 or log(ξ)=0). The sign of log (ξ) indicates the direction of the skewness. The third moment is positive, and the density is skewed to the right, if log (ξ)>0. On the contrary, the third moment is negative, and the density is skewed to the left, if log (ξ)<0. We can confirm that the density distributions of all series are skewed to the right side due to these significantly positive asymmetric terms.

The tail term (υ) is much larger for the BRA CDS returns than for the other series. This means that daily returns of the BRA CDS premiums display a much larger kurtosis and exhibit fatter tails than returns for the RUS, SOA and TUR premiums. Besides, the evidences show that fat-tail phenomenon is strong because the student or tail terms (υ) are significantly different from zero for all series under Skewed Student-t distribution.

The results given in Table 3 show that the APGARCH succeeds in taking into account all the dynamical structure exhibited by the returns and volatility of the returns as the Ljung-Box statistics for up to 20 lags on the standardized residuals (Q) non-significant at the 5% level (except BRA, RUS, SOA and TUR CDS return series) and the squared standardized residuals (Q^2) non-significant at the 5% level for all CDS return series. Also, there is no evidence of remaining ARCH effects according to the ARCH test statistic with lag 5. In addition, goodness-of-fit test statistics for 60 cells P(60) verify again the relevance of Skewed Student-t distribution for all CDS returns. Thus, the Skewed Student-t distribution

can be used to capture the tendency of CDS return distribution referring to leptokurtosis.

CONCLUSION

A recent development in the ARCH literature has been the introduction of the Power ARCH class of models which allow a free power term rather than assuming an absolute or squared term in their specification. Accordingly, the purpose of the current paper is to consider the applicability of the Generalized Asymmetric Power ARCH (APGARCH) model to the selected CDS returns for five countries. The CDS premiums are investigated by using the APGARCH (1,1) model under Normal, Student-t , GED and Skewed Student-t distributions. We found that the Skewed Student-t distribution is the most efficient. To capture the long memory property exhibited in the conditional variance, the power term (δ) estimates of APGARCH model is in the interval between 0.6986 and 1.4403. It indicates that the return series of all CDS premiums are skewed distributed and have fat tails by the significant coefficients of ξ (not significant for SOA) and υ in the results of model estimation. The Skewed Student-t density appears to be a promising specification to accommodate both the high kurtosis and the skewness inherent to most asset returns.

The estimation results indicate that strong leverage effects are present in CDS return data especially for TUR and BRA. Further, once these leverage effect are modeled in a GARCH framework, the inclusion of a power term is a worthwhile addition to the specification of the model. Also, in these emerging economies the volatility persistence is higher. Thus, shocks in the CDS return series have substantial memory effects. Because of the tail term is higher, the CDS returns display larger kurtosis and exhibit fatter tails.

The CDS returns' volatility has increased during the global crisis period. The most affected countries are seen as Russia and Brazil. Especially after global crisis, the CDS market has become important in more recent years globally, especially for emerging countries where sovereign risk is an important indicator to foreign investors in assessing risks of their foreign direct investment and portfolio investments. In a well-functioning financial market, the CDS returns reflects the riskiness of the underlying event.

Consequently, in this paper, the ability of the APGARCH model is analyzed so as to present the volatility characteristics of five emerging economies. However internal dynamics of each economy are different, it is concluded that for all CDS returns the positive shocks lead to higher subsequent volatility and also contain long memory process.

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