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The Effects of External Debt on the Economic Growth of India during Various Crisis Periods: A Markov-Switching GARCH Model Approach

Raktim Ghosh [1], Biswajit Paul [2], Bhaskar Bagchi [2],* and Priyajit Kumar Ghosh [3]

[1] Maharaja Srischandra College, Kolkata (700003), West Bengal, India
[2] University of Gour Banga, Malda (732103), West Bengal, India
[3] Sister Nivedita University, Kolkata (700156), West Bengal, India
* Correspondence: bagchi_bhaskar@yahoo.in

Abstract: This article seeks to investigate the impact of the volatility of the external debt burden on the economic growth of India. The MS (Markov - Switching) - GARCH model is the cornerstone in studying the effects of external debt on the economic growth that is simulated herein. This article applies a MS - GARCH model that allows not only unobserved variables within an observed model but also uses a robust algorithm to reach strong optimization (convergence) through iteration in a dynamic system in the estimation procedure. This article considers the period from Q2 2004 to Q4 2022 with 74 sample observations. Considering various crises like the global financial crisis, the Euro crisis, and the COVID-19 pandemic that occurred during the study period, the results identify two regimes based on conditional volatility. One is the global financial recession period (regime-1) and another is the post-global financial recession period (regime-2). The findings show that the conditional volatility as well as the variance in the volatility of economic growth due to the external debt of India is much stronger in the global financial recession period (regime-1) than in the post-global financial recession period (regime-2). It implies that the Euro crisis and the COVID-19 pandemic are having less impact on external debts in India. The transition matrix indicates the greater probability of the economic growth rate settling down in regime 2 when it is already in regime 2, as it is considered to be a much calmer period. Finally, the results of the stable probabilities suggest that the economic growth rate of India is much more stable in regime 2 than in regime 1. This article puts forward relevant policy implications for coming out from the debt overhang scenario in India.

Keywords: External Debt; Economic Growth; MS - GARCH; Volatility

1. Introduction

The government of a country requires an adequate amount of funds to sustain its economic growth. However, if the government is unable to arrange the required amount of funds through its revenue-generating sources to support its development, it needs to borrow funds. In such a case, the government may borrow funds either from internal (the domestic market) sources or external (foreign nations) sources (Kasasbeh, 2021) [1]. Developing countries often experience issues such as a current account deficit, low productivity, low domestic savings, and a lack of internal capital generation (Kasasbeh, 2021 [1]; Kasidi and Said, 2013 [2]). In these instances, developing countries

usually borrow funds from overseas in the form of external debt to bridge the gap caused by insufficient domestic capital generation (Ayadi and Ayadi, 2008 [3]; Kasidi and Said, 2013 [2]). Further, external debt can be used to finance development projects that would not be possible to fund with domestic resources alone. This can include projects in infrastructure, education, healthcare, and other areas that are essential for economic growth. However, there are also some risks associated with the use of external debt. The borrowing country may not be able to repay the debt, which could lead to a debt crisis. The debt service burden may become too high, which could crowd out spending on other important priorities. The debt may be used to finance unproductive projects, which could lead to economic stagnation. Furthermore, it can lead to higher tax rates to serve debt. Moreover, the excessive use of external debt hinders economic growth in developing countries by aggravating poverty and overusing the labor force (Ayadi and Ayadi, 2008) [3]. Here, government policy decisions play a vital role. According to the study of Bordo et al. (2010) [4] a government's policy decisions, particularly how the debt is handled and managed by the government, determine the effects of external debt on economic growth.

The relationship between external debt and economic growth is a complex one that has been studied by economists for many years. There is no simple answer, as the impact of external debt on economic growth depends on several factors, including the level of external debt, the use of borrowed funds, and the overall economic conditions of the country, etc. According to the study of Bakar and Hassan (2008) [5], external debt is beneficial to the economic development of a country. Safdari and Mehrizi (2011) [6], Sulaiman and Azeez (2012) [7], Ezema et al. (2018) [8], and others stated that external debt is used as one of the important sources of financing for investment in infrastructure, education, and other productive activities that can boost economic growth and promote public welfare. Sharaf, M. F. (2022) [9] argued that a favorable relationship between external debt and economic growth is feasible when perfect capital mobility exists. On the other hand, several scholarly studies, including Atique and Malik (2012) [10], Kharusi and Ada (2018) [11], and Shkolnyk et al. (2018) [12], revealed that external debt hinders a nation's ability to grow independently. If the level of external debt of a country becomes too high, it can have a negative impact on economic growth. This is due to the crowding effect, which occurs when there is substantial use of external debt by the government and can result in higher interest rates making it more expensive for businesses to borrow money and invest (Iyoha, 1999 [13]; Tuffour, 2012 [14]). According to the study of Hameed et al. (2008) [15], a country's high external debt led to a reduction in private investment in the borrowers' nation. Safdari and Mehrizi (2011) [6] also found a similar inverse relationship between external debt and GDP. Whereas, Toktaş et al. (2019) [16] and Reinhart and Rogoff (2010) [17], stated a certain level of debt to gross domestic product ratio as a threshold level in their analyses. They found that if the level of external debt exists below that threshold level, external debt has a positive impact on economic growth, while it has an adverse impact beyond that threshold level. This is because external debt becomes a burden on a country's economy beyond that threshold level. If a country borrows too much money from overseas, it becomes difficult for those countries to repay the debt. This can lead to a debt crisis, which has a devastating impact on the economy. However, it is important to note that there is still no agreement on the ideal threshold level (Sharaf, 2022 [9]; Toktaş, 2019 [16]).

Since its independence, external debt has been used as a door to finance fiscal deficits and numerous developmental projects in India (Joy and Panda, 2019 [18]; Saxena and Shanker, 2018 [19]). Further, in the nineties, India used to finance the balance of payments deficit and avoid a shortage of

foreign exchange (Saxena and Shanker, 2018) [19]. However, the outbreak of the COVID-19 pandemic triggered unprecedented growth in India's external debt. According to a PIB report posted on 5th September 2022, by the end of March 2022, India's external debt has climbed by 8.2% from the year-earlier period (i.e., March 2021). However, this scenario has not changed in 2023. By the end of March 2023, India's external debt reached $624.7 billion (RBI data released on 30th June 2023). This is an increase of $5.6 billion from the year-earlier period (i.e., March 2022), which is a serious issue as far as the negative impact of external debt is concerned. Therefore, under such circumstances, it is felt quite imperative to evaluate the effects of external debt on India's economic growth.

In recent years, however, a large number of studies have examined how external debt influences economic growth. These include Suryandaru (2023) [20]; Udemba et al. (2023) [21]; Ghauri et al. (2022) [22]; Thiora (2021) [23]; Yusuf & Mohd (2021) [24]; Awan & Qasim (2020) [25]; Kharusi & Ada (2018) [11], and many more. But, the majority of these studies used the ARDL model and VECM method. However, the effects of external debt on India's economic growth by using the Breakpoint Unit Root test and Markov-switching GARCH model considering various crisis periods, such as the Global Financial Crisis, the Euro Crisis, and the COVID-19 pandemic, has not been examined in any prior research. This Markov-switching GARCH model is useful for better forecasting and for comprehending the dynamics of time series data.

It is quite expected that various crises that occurred over the years can produce significant structural breaks as well as variations in economic time series datasets and accordingly abrupt changes in government policies are also witnessed (Hamilton and Lin, 1996) [26]. Under such conditions, Markov Switching models are used that can capture abrupt changes in the parameters within models. The main concept is to augment a latent variable that can demonstrate the switchover of the parameters when the procedure enters a new regime from another regime. The Bayesian approximation of the Markov-switching GARCH model uses the Maximum Likelihood (ML) estimator and takes into consideration different possible volatility breaks. Again, Markov-switching GARCH models permit time-varying skewness in contrast to the typical univariate GARCH-type models. Furthermore, the MS-GARCH model permits to shift between diverse regimes contrary to the standard GARCH models. It has been revealed from the findings of the present study that the conditional volatility as well as the variance in volatility of economic growth due to external debt of India is much stronger in the global financial recession period (regime-1) than in the post-global financial recession period (regime-2). This implies that the Euro crisis and the COVID-19 pandemic are having less impact on external debts in India. The transition matrix indicates the greater probability of the GDP growth rate settling down in regime 2 when it is already in regime 2, as it is considered to be a much calmer period. Finally, the results of the stable probabilities suggest that the GDP growth rate of India is much more stable in regime 2 than in regime 1.

As far as the literature on external debt and economic growth is concerned, these findings are unique and exclusive. Because most of the earlier literature on this area applied constant variance scale parameters and none of them had applied Markov-switching GARCH models. This study applied a Markov-switching GARCH model that allows not only unobserved variables within an observed model but also uses a robust algorithm to reach strong optimization (convergence) through iteration in a dynamic system in the estimation procedure. Moreover, the findings also highlight the volatility impact of external debt on economic growth during recent crises like the COVID-19

pandemic. Thus, the findings of our present study are expected to make a significant and noteworthy contribution to the existing literature on external debt and economic growth.

The remaining sections of the paper are arranged as follows: section 2 discusses earlier literature in the field, and Section 3 outlines the methodology applied in this study. The empirical results and discussions are presented in section 4. Section 5 presents concluding remarks along with the recommendations and limitations of this study.

2. Synthesis of Literature

The literature review, research gaps, and research objectives are all presented in this section. The researchers have carefully evaluated the available literature and presented the findings of those studies below.

Korkmaz (2015) [27] studied the impact of external debt on economic growth in Turkey from 2003 to 2014 by employing the Vector Autoregression (VAR) model, Johansen Cointegration Test, and the Granger causality test. The results of the study revealed that in the long run, there was a positive and statistically significant relationship between external debt and GDP in Turkey. Further, the Granger causality test revealed that a one-way causality exists from external debt to economic growth. Kharusi and Ada (2018) [11] examined the link between external debts and economic growth in Oman by using the autoregressive distributed lag (ARDL) model and vector error-correction model during the period from 1990 to 2015. The findings of this study demonstrated that there was a negative and significant relationship between external debts and economic growth in Oman at a 5% significance level. This study found a 1% rise in external debt caused a 0.04% decline in the GDP growth rate. Further, the findings of this study corroborate the debt overhang theory and crowding-out effect. Saxena and Shanker (2018) [19] studied the behavioral relationship between external debt and the economic development of India during the period from 1990 to 2016 by using the Ordinal Least Square analysis (OLS) method. The findings of this study demonstrated that there was a negative and significant relationship between external debts and economic development in India at a 5% significance level. This study found a 1% rise in external debt caused a 0.076% decline in GDP. Similarly, a 1% rise in Debt Service Ratio caused a 0.004% decline in GDP. This outcome is corroborated by the results of the study carried out by Moh'd AL-Tamimi and Muhammad (2019) [28]. Moh'd AL-Tamimi and Muhammad (2019) [28] found external debt had a negative and significant impact on the economic growth of Jordan. The study by Fetai and Avdimetaj (2020) [29] intended to investigate the relationship between public debt and economic growth by employing pooled OLS, panel regression model, and GMM (Generalized Method of Moments). The study constructed a panel dataset of eight Western Balkan countries over the years 1995 to 2017. The findings of this study demonstrated that there was a concave relationship exists between public debt and economic growth in Western Balkan countries. This study found that the threshold value of public debt is 53.37%. Results showed once a public debt exceeded the threshold value of 53.37%, public debt started to harm the economic growth of Western Balkan countries. Awan and Qasim (2020) [25] used the ARDL Model and error correction model to evaluate how Pakistan's external debt affected economic growth. In this study, researchers considered the time series data of Pakistan for the period from 1980 to 2017. This study concluded that both the long-term and short-term effects of external debt on economic growth were negative and statistically significant. Thiora (2021) [23] employed the autoregressive distributed lag (ARDL) bounds test and the vector error-correction

model to look into the effects of external debt stocks on Kenyan economic growth from 1970 to 2018. The results of this study found a significant relationship between the real GDP and the external debt stock-to-GDP ratio. The findings of this study contradict the debt overhang theory. This signifies that still, Kenya's external debt stock to GDP ratio is still below the threshold level. Sharaf, M. F. (2022) [9] aimed to investigate the asymmetric and threshold effects of external debt on the GDP of Egypt. The autoregressive distributed lag (ARDL), non-linear autoregressive distributed lag (NARDL) bounds test, and vector error-correction model were used in this study, which covered the years from 1980 to 2019. This found that the growth impact of external debt was symmetric in both the short and long runs. Further, this study revealed that the threshold value of external debt to gross domestic product (GDP) ratio is 96.70%. Results showed once an external debt-to-GDP ratio exceeded the threshold value of 96.70%, the effect of external debt on GDP growth switched from positive to negative. The study of Ale et al. (2023) [30] intended to investigate how external debt affects the economic growth of South Asian nations during the period from 1980 to 2020 by using the Cross-sectionally Augmented Panel Unit Root Test and Panel Autoregressive Distributed Lag (ARDL) approach. This study found external debt had a negative effect on South Asian nations' economic growth both in the short and long run. According to Udemba et al. (2023) [21], the debt-to-GDP ratio, foreign direct investment, investment, capital, and inflation all had a positive effect on India's economic development. On the flip side, this study found trade openness and population had a negative effect on India's economic development.

After carefully examining the available literature, it is found that the majority of the prior literature adopted the ARDL model and VECM technique to evaluate how external debt affects economic growth. However, no such studies have investigated the association between external debt and the GDP growth of a country using the Breakpoint Unit Root test and the Markov-switching GARCH (MS-GARCH) model. Markov-switching GARCH (MS-GARCH) models are a type of time series model that can be employed to detect the presence of regime changes in time series volatility. The conditional variance of the time series is permitted to change over time in an MS-GARCH model following a latent discrete Markov process. This can be useful for better forecasting and for comprehending the dynamics of time series data. Whereas, the Breakpoint Unit Root test is used to assess whether a time series data has a unit root when there is a structural break. A structural break occurs when the trend or mean of a time series data abruptly and permanently changes. The Breakpoint unit root test is crucial because it can assist in overcoming the shortcomings of conventional unit root tests, which were not designed to handle structural breaks. Furthermore, no prior research has examined how external debt has affected India's economic growth throughout various instances of crisis, such as the Global Financial Crisis and the COVID-19 pandemic. Taking into account all the aforementioned points as a significant research gap in this area, this study, which spans from Q2 2004 to Q4 2022, intends to analyze the effect of India's external debt on the GDP growth rate by using Breakpoint Unit Root test and Markov-switching GARCH (MS-GARCH) model during the period from Q2 2004 to Q4 2022.

3. Research Methodology

This study considered quarterly closing return data of gross total India's external debt (million) including total long-term debt, multilateral debt, bilateral debt, trade credit, commercial borrowing, NRI deposits, rupee debt, short-term debt, others (trade related), FII Investments in Government T-

Bills and other instruments, Investment in Treasury Bills by Foreign central Banks and external debt Liabilities. Moreover, it also considered the GDP growth rate of India as a proxy for economic growth. The data on gross total India's external debt is collected from the database of the Reserve Bank of India (RBI) and the data on the GDP of India is collected from the database of CEIC. The period of the study starts from Q2 2004 to Q4 2022 with 74 sample observations.

The Markov Switching GARCH (MS GARCH) model is applied to study the conditional volatility from the external debt of India to the GDP growth rate during the global financial recession period and the post-global financial recession period. The recession period is selected based on the report of the Business Cycle Dating Committee (USA). Moreover, the Breakpoint unit root test is also used to study the non-existence of unit root problems within the data along with the break-point date. Furthermore, descriptive statistics is also used to study the nature of the data.

It has been found that the applications of Markov Switching models have been confirmed and advocated in numerous arenas of studies in economics and finance, and even in engineering (Chauvet, 2000 [31]; Guo et al., 2016 [32]; Zhang and Hong, 2019 [33]). Chauvet (2000) [31] and Misas and Ramirez (2007) [34] were among the pioneers who used Markov Switching models to estimate the probabilities of whether a particular country is passing through a recession regime or a growth regime. Moreover, Markov Switching models were also applied to check the possible existence of normal deviations in economic cycles (Camacho and Perez-Quiros, 2014 [35]; Dufrenot and Keddad, 2014 [36]; Hamilton and Lin, 1996 [26]; Misas and Ramirez, 2007 [34]). Again, Klein (2013) [37], applied Markov Switching models to investigate the existence of time-varying behaviour in the stock markets of European countries and the United States.

However, the present study is motivated by the exemplary work of Zheng and Zuo (2013) [38], which used the Markov Switching models to find out the spillover effects between stock markets of developed nations and decided to apply the Markov Switching GARCH model in the present study. This model is particularly appropriate to examine the impact of external debt on economic growth in different regimes. More specifically, external debt is allowed to shift in the mean and variance, that is, for periods of expansion and contraction and high volatility and low volatility. The model allows not only unobserved variables within an observed model but also uses a robust algorithm to reach strong optimization (convergence) through iteration in a dynamic system in the estimation procedure. Specifically, concerning our study, the undertaken approach is appealing because it fits the fact that external debt can affect the domestic economy in different ways during different crisis periods. Another motivation for using this approach is the patterns of economic growth of India, which historically switches from one regime to another in response to different financial crises. Moreover, the authors also followed the novelty of the following works namely Bagchi and Paul (2023) [39], Bagchi et al. (2023) [40], Ghosh et al. (2023) [41], Bagchi et al. (2020) [42], and Bagchi (2017) [43].

3.1. Break Point Unit Root Test

A statistical method for identifying structural breakdowns in time series data and determining if a unit root exists in each data segment is the Breakpoint Unit Root Test.

When a time series' statistical characteristic is that its root value or solution is one, the time series is said to have a unit root. This suggests that the series has a stochastic tendency and is not stationary.

In economics and finance, unit root tests are frequently used to check if time series data have long-run dependencies.

It is predicated on the idea that structural breakdowns in the data could happen and that the stationarity characteristics of the data could alter both before and after a break. The purpose of the test is to identify instances of structural breaks and assess whether each segment of the data contains a unit root.

To conduct the test, the time series must be split into two or more segments. Each segment must then be subjected to a unit root test independently. If the unit root null hypothesis is disproved in one or more segments, it is possible that a structural break has taken place and that the series is stationary in those segments.

A complete augmented Dickey-Fuller test was performed using Perron's (1989 [44], 1997 [45]) projected innovation outlier breakpoints. The models below used a methodology that relies on the correlation function, the innovation (also known as noise) process, and a variable for a consistent change in the intercept of the trend function (Perron, 1997) [45].

$$\Delta y_t = \mu + \theta DU_t + \beta_t + \phi D(T_b)_t + \alpha y_{t-1} + \sum_{i=1}^{k} z_i \Delta y_{t-i} + \varepsilon_t \tag{1}$$

$$\Delta y_t = \mu + \theta DU_t + \beta_t + \omega DT_t + \phi D(T_b)_t + \alpha y_{t-1} + \sum_{i=1}^{k} z_i \Delta y_{t-i} + \varepsilon_t \tag{2}$$

According to Perron (1989 [44] & 1997 [45]), the breakpoint Tb can be chosen so that is limited. It is stated what the shortened t-statistic is:

$$t_{\hat{a}}^* = \min_{T_{b\xi(k+1,T)}} t_{\hat{a}}(T_b, k) \tag{3}$$

3.2. Markov Switching GARCH (MS-GARCH) Model

Before applying this model, a statistical description of the data and a goodness of fit test are made, to determine whether the two-regime MS, MS-ARCH, or MS-GARCH models are suitable for the volatility studied herein.

According to the study of Francq et al. (2001) [46], the MS-GARCH model can be formulated by the following equations:

$$y_t = \mu_{St} + \sigma_t(S_{1t})n_t \tag{4}$$

$$\sigma_t^2(S_{1t}) = \varpi_{St} + \alpha_{St}\varepsilon_{t-1}^2(S_{t-1}) + \beta_c\sigma_{t-1}^2(S_{1It-1}) \tag{5}$$

$$\varepsilon_{t-1}(S_{t-1}) = y_{t-1} - \mu_{St-1} \tag{6}$$

Where the vectors $y_1, y_2, \ldots, y_T$ are the observations to be modeled and n_t, t=1, …, T are independently and identically distributed normal innovations with zero mean and unit variance. At every time point, the conditional mean of the observations y_t is μ_{st} = E (y_t I S_t) and the conditional variance is

$$\sigma_t^2(S_{1t}) = Var(y_t \, I \, y_{1t-1,} S_{1t}) \tag{7}$$

where $y_1{}_{t-1}$ and S_{1t} are shorthand for the vectors ($y_1, y_2, \ldots, y_{t-1}$) and ($S_1, \ldots, S_t$), respectively. The process {S_t} is an observed ergodic time-homogeneous Markov chain with N-dimensional discrete state space

(i.e., St can take integer values from 1 to N). The N * N transition matrix of the Markov chain is defined by the transition probabilities

$$P_{ij} = P_r(S_t = j \mid S_{t-1} = i)_{i.j=1}^{N} \qquad (8)$$

The vector is:

$$\theta = (\{\mu_i, \varpi_j, \alpha_i, \beta_i\}_{i,j=1}^{N}) \qquad (9)$$

denotes the parameters of the model (Nelson, 1991) [47].

In estimating the parameters of the Markov switching GARCH models, we checked two methods of estimation: the maximum likelihood method and the Monte-Carlo Markov chain method which suggested that the two regime-switching performed better.

4. Results and Discussions

4.1. Descriptive Statistics

Table 1. Descriptive Statistics of External Debt and GDP Growth Rate of India.

Variables	External Debt	GDP Growth Rate
Mean	0.0308	-0.0064
Median	0.0281	-0.0819
Maximum	0.1177	3.0522
Minimum	-0.04	-1.8725
Jarque-Bera	3.926	285.81
p-value	0.1404	0.00*
Observations	74	74

(* indicates significance at 1% level)

Table 1 denotes the descriptive statistics of the select variables of the study namely external debt and GDP growth rate of India during the study period Q2 2004 to Q4 2022. The external debt of India increased to 0.1177 and reached a lowest of -0.04 with a mean value of 0.0308. Likewise, the GDP growth rate increased to 3.0522 and decreased to -1.8725 with a mean of -0.0064. The data of external debt is normal in nature with an insignificant p-value of 0.1404. On the contrary, the GDP growth rate demonstrates a non-normal behavior as confirmed by the significant p-value of the Jarque-Bera test.

4.2. Breakpoint Unit Root Test (Innovation Outlier Model)

The breakpoint unit root test is applied to identify the stationarity nature of data along with the breakpoint within it.

Table 2 demonstrates the result of the breakpoint unit root test of the variables of the study namely external debt and GDP growth rate of India during the study period Q2 2004 to Q4 2022. It is observed that for external debt, though there exists a unit root problem at the level, at the first difference there is no problem of a unit root. On the contrary, the GDP growth rate is significant at both levels, and the first difference indicates no problem of unit root. The breakpoint of external debt lies in Q2-2011, whereas, the GDP growth rate has a breakpoint in Q4-2020. The empirical findings of

the above test align with the theoretical occurrences witnessed across historical times.

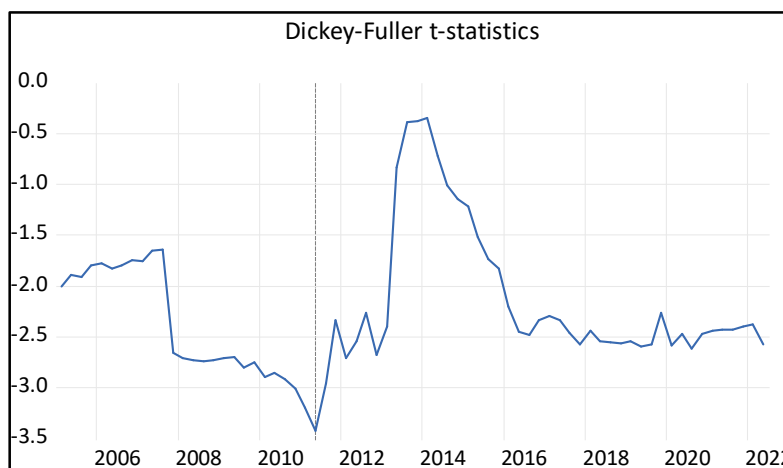**Table 2.** Breakpoint Unit Root Test of External Debt and GDP Growth Rate of India.

Variables	At Level		At First Difference		Break Point
	t-Statistic	p-value	t-Statistic	p-value	
External Debt	-3.4187	0.85	-8.2022	0.00*	Q2-2011
GDP Growth Rate	-6.1508	0.00*	-12.6077	0.00*	Q4-2020

(* indicates significance at 1% level)

The possible economic significances of finding these two structural breakpoints of external debt in Q2-2011 and the GDP growth rate in Q4-2020 are the indicators of India's external vulnerability that have been showing symptoms of stress recently, because of the impact of a worsening sovereign debt crisis in the Eurozone and the global slowdown during the beginning of 2011 (Dept. of Economic Affairs, Ministry of Finance, Govt. of India) [48]. The recession officially ended in the second quarter of 2009, but the nation's economy continued to be described as in an 'economic malaise' till the second quarter of 2011. Some economists described the post-recession years as the weakest recovery since the Great Depression. Also at that time, we found the 2011 U.S. Debt Ceiling Crisis' which affected the external debt extremely. Moreover, to constrict the monetary policy, interest rates were escalated which also had an impact on the external debt dynamics. Furthermore, the increase in the global crude oil price and exchange rate fluctuation in the world market are also some key factors that had a significant impact on the external debt of India.

In the year 2020, the entire globe suffered from the worldwide pandemic, COVID-19 that had a severe impact on the macroeconomic framework of almost all the countries. India was also a victim of the same. To hinder the spread of the virus, the Government decided to impose a nationwide lockdown that affected cross-border trade leading to an effect on the Government exchequer in terms of foreign exchange earning deficits. Moreover, following the nationwide suspension of free movement, the economy of India was also severely affected. The service sector as well as the other sectors underwent a downturn in terms of its performance. All these lead to poor GDP growth in India.

The breakpoint unit root test can be graphically represented below in Figures 1 and 2:

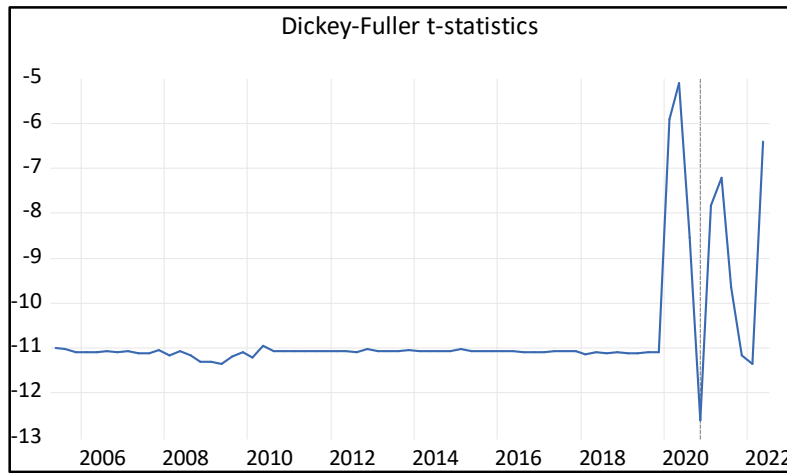**Figure 1.** Breakpoint Unit Root Test of External Debt of India.

Figure 2. Breakpoint Unit Root Test of GDP Growth Rate of India.

4.3. Markov Switching GARCH (MS-GARCH) Model

Table 3. Results of the MS GARCH Model.

Fitted Parameters	Estimate	Standard Error	t value	Pr (>|t|)
α_{01}	0.11	0.06	2.02	0.021*
α_{11}	0.99	0.00	2.23	0.00*
β_1	0.01	0	5.85	0.00*
α_{02}	0.10	0.04	2.60	0.01*
α_{12}	0.99	0.00	2.79	0.00*
β_2	0.00	0.00	5.85	0.01*

(* indicates significance at 1% level)

The MS GARCH model is used to study the conditional volatility and variance in volatility within a dependent variable due to an independent variable along with switching over of the dependent variable across a multi-regime framework. Moreover, it also allows capturing the transition probabilities along with the stable probabilities.

This study used the MS GARCH model to capture the conditional volatility within the GDP growth rate of India from the external debt during the global financial recession period and the post-global financial recession period. The above table typically represents the results of the MS GARCH model where the GDP growth rate of India is the dependent variable and the External Debt of India is the independent variable. The equation of this study is framed as under:

$$GDP\ Growth\ Rate_{74} = External\ Debt_{74\,\varepsilon74}\ [_{\varepsilon74}\ N \sim (0,1)] \tag{10}$$

Under the fitted parameters, α_{01} represents the conditional volatility in the GDP growth rate due to the external debt of India in regime 1. α_{11} denotes the conditional volatility in the GDP growth rate due to the external debt of India in regime 1 when there is high probability of GDP growth rate to remain in regime 1. β_1 denotes the variance in the volatility of the GDP growth rate due to the external debt of India in regime 1 whereas β_2 signifies the variance in the volatility of the GDP growth rate due to the external debt of India in regime 2. α_{02} denotes the conditional volatility in the GDP growth rate due to the external debt of India in the 2nd regime or regime. Likewise, α_{12} denotes the conditional volatility in the GDP growth rate due to the external debt of India in Regime 1 and has a high probability of shifting to regime 2.

It is observed that for all the fitted parameters, the p-value is significant at the 1 per cent level with a 99 per cent confidence interval. Hence, a stronger presence of conditional volatility and variance in volatility is noted in the GDP growth rate due to the external debt of India across all the regimes. Moreover, it needs to be highlighted that the conditional volatility as well as the variance in volatility is much stronger in the global financial recession period (Regime 1) than in the post-global financial recession period (Regime 2) due to a greater coefficient value in regime 1.

The problem of higher external debt has remained a perennial problem for India. During the time of the global financial recession period, the problem of external debt along with the effect of the recession led to a multiplier effect on the GDP growth rate of India which led to conditional volatility as well as variance in volatility. GDP growth slowed from 9% in 2007-08 to 7.8% in April-September 2008 (Aiyar, 2009) [49]. Moreover, it is noteworthy to mention that India has been impacted by the global crisis in three different ways: through the financial markets, trade flows, and exchange rates. When capital inflows stopped, it led to a credit constraint in domestic markets and the Gross domestic product fell as a result of a substantial fall in export demand. GDP in the fiscal year 2008–2009 decreased by more than two percentage points. According to efforts globally adopted by national governments and central banks, the Government and the Reserve Bank of India implemented forceful countercyclical measures by drastically easing monetary policy (Kumar and Vashisht, 2009) [50].

The conditional volatility of the GDP growth rate from the external debt of India across Regime 1 and Regime 2 can be demonstrated graphically below in Figure 3:
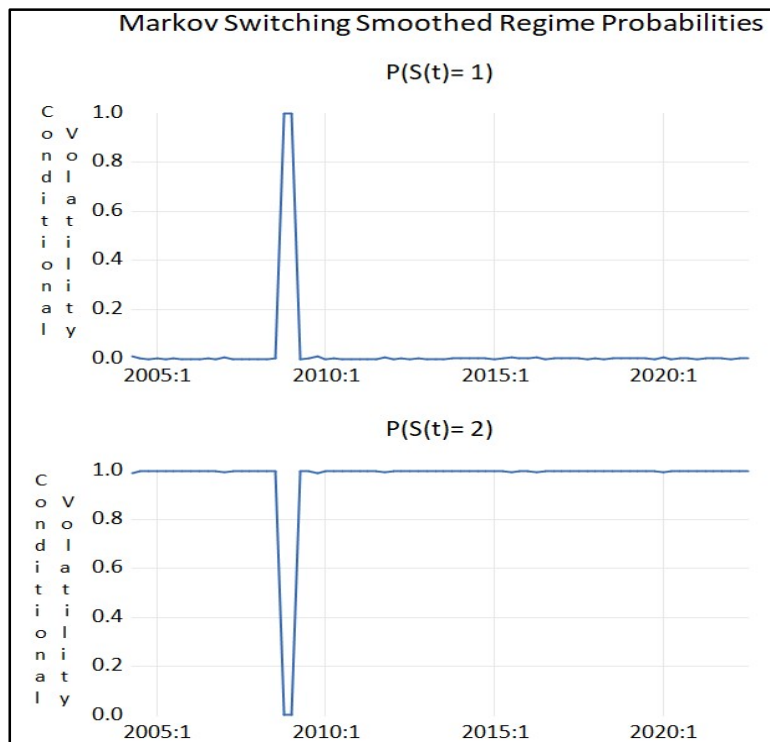
Figure 3. Conditional Volatility in Regimes 1 and 2.

Table 4 denotes the transition matrix of the dependent variable namely the GDP growth rate of India. K (1, 1) indicates the probability of the variable remaining in regime 1 when it is already in regime 1 which is 0.8801. K (1, 2) denotes the possibility of the variable shifting to regime 2 from regime 1 which is 0.1199. K (2, 1) denotes the likelihood of the GDP growth rate of India to come back

to regime 1 when it is already in regime 2 which is 0.0371. Finally, we have K (2, 2) which is 0.9629 indicating that there is a high probability of the GDP growth rate settling down in regime 2 when it is already in regime 2. This is so because regime 2 is the post-recession period which is much calmer.

Table 4. Results of the Transition Matrix.

Transition Matrix		
--	K=1	K=2
K=1	0.8801	0.1199
K=2	0.0371	0.9629

Table 5 suggests that the GDP growth rate of India is much more stable in regime 2 which is 0.7637 than in regime 1 which is 0.2363.

Table 5. Results of the Stable Probabilities.

Stable Probabilities	
State 1	State 2
0.2363	0.7637

5. Conclusion, Recommendations, and Limitations of the Study

The inadequate financial resources in the development process of developing countries such as Turkey caused these countries to head towards external resources through borrowing. In this case, the external debt becomes a highly important resource in the elimination of the inadequacy of the domestic capital accumulation, in the financing of some of the large investments, and in the economic growth.

In this study, the effect of external debt on India's economic growth is examined using the Markov-switching GARCH model during various crisis periods such as the Global Financial Crisis, the Euro Crisis, and the COVID-19 pandemic. Applying the Markov-switching GARCH model, we found two regimes covering our period i.e., the global financial recession period (Regime-1) and the post-global financial recession period (Regime-2). Conclusively, the conditional volatility as well as the variance in volatility of economic growth due to the external debt of India is much stronger in the global financial recession period (Regime-1) than in the post-global financial recession period (Regime-2). Therefore, the findings of this study ensure that the Euro Crisis and the COVID-19 pandemic are having less impact on external debts in India and there is a need to put in place appropriate debt policy measures by the Indian Government.

Based on the findings of the study, one of the probable reasons for the lesser impact of external debt on economic growth during the Euro Crisis and the COVID-19 pandemic may be the political stability as well as the existence of a stable government policy on external debt. Therefore, it is recommended that the government should ensure economic and political stability to enjoy the benefits of external debt in the holistic economic growth of the country and make the debt burden minimal.

However, it is evident from the existing literature that public external debt harms economic growth more than private external debt. This finding suggests that the government should make public external debt policy to restrict the inefficient use of it during any financial crisis period and

policymakers should ensure that the external debt burden is curtailed through effective external debt management policy in India.

Regarding limitations of the study, it may be stated that the variables like GDP growth rate and external debt have been considered but, GDP growth rate is largely influenced by the lag of GDP growth rate. Thus, the past value of GDP influences the current value, and consideration of different lags of GDP could have produced better results.

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