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Empirical Examination of Relationship amongst External Debt, Debt Servicing and Economic Growth in India: A Toda-Yamamoto Causality Approach

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Abstract

This study examines the relationship amongst external debt, debt servicing, and economic growth in India during the post-economic reform era. The Toda-Yamamoto causality test methodology is employed in this study to examine the relationships among the variables. Initially, the optimum lag length was selected based on LR, FPE, AIC, SIC and HQ. Then the unit root tests were performed using the Augmented Dickey Fuller (ADF) test, and the results indicated that the variables are *I(1)*. Therefore, the Johansen cointegration test was performed and the trace statistics and maximum eigenvalues indicated no cointegration amongst the variables. These results aligned with the findings of the previous studies. Ultimately, the Block Exogeneity Wald test was performed to determine the existence and direction of causality among the variables. The results indicated that neither the external debt nor the debt servicing significantly causes change in nation's GDP. However, economic growth significantly influences external borrowing and debt-servicing capacity, highlighting the critical role of sustained GDP growth in managing external debt sustainably. Hence, the study suggests that policymakers should focus on enhancing productivity, boosting exports, and strengthening institutional frameworks to ensure the productive use of borrowed resources.

Keywords: Debt Servicing, External Debt, Economic Growth, India, Johansen Cointegration, Toda-Yamamoto Causality

1. Introduction

The relationship amongst external debt, debt servicing, and economic growth remains a significant field of economic research and policy analysis. Understanding the dynamic relationship amongst these variables is particularly important for developing economies, where external debt is crucial for funding economic growth and infrastructure development. India, as an emerging nation, provides an important case for examining these interactions. While external debt helps to alleviate resource deficiencies and facilitate development, it also poses risks of fiscal instability and causes slower economic growth when it is improperly managed (Pillarisetti, 1991). Therefore, more empirical investigation into these intricate relationships is significant for policymakers to determine if an increase in external debt facilitates debt servicing and promotes the nation's economic growth. India's economic liberalization in 1991 marked a substantial transition from protectionism to a market-oriented approach which led to increased dependence on external debt to finance growth-oriented projects and handle fiscal deficits (Sridharan, 1993). However, this reliance made India vulnerable to global crises, as evidenced during the 2008 financial crisis. It is often perceived that

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this global crisis has had a minimal impact on India; however, due to the country's increased openness and the worldwide liquidity crisis, the corporate and banking sectors' borrowings from abroad were lesser during this period (Arora *et al.*, 2010). Nevertheless, the trend of the nation's external debt saw massive growth during the recent decade. The Economic Outlook published by the Centre for Monitoring Indian Economy reveals that India's external debt increased from Rs. 1,17,86,380 million in 2009-10 to Rs. 4,19,76,520 million in 2019-20. The significant rise in the country's external debt is concerning, necessitating an urgent inquiry to assess its impact on economic growth. According to Bal and Rath (2014), India's growing dependence on external debt after the economic liberalization facilitated short-term economic progress but created issues for long-term fiscal sustainability.

Another challenge for developing countries such as India is that they find themselves channelling a significant portion of their foreign exchange earnings and new loan disbursements toward servicing existing debts rather than fostering productive investments. According to Lee (2023), the rapid increase in external debt among developing countries in Asia has been paralleled by a faster rise in debt-servicing obligations. This imbalance is driven by high borrowing rates from international commercial banks and increasing global interest rates.

Thus, this study attempts to examine the relationship between external debt, debt servicing, and economic growth in India after economic liberalization to uncover the conditions under which external debt transitions from a developmental asset to a fiscal liability. The relevance of this study also extends to other emerging economies facing similar debt dynamics. By situating India's experience within the broader global discourse, this study seeks to advance understanding of the external debt-growth nexus and its implications for sustainable development.

2. Literature Review

Numerous studies were conducted to examine the complex relationship between external debt, debt servicing and economic growth in the context of several nations, including India, across different periods and using various econometric methodologies. This section highlights the findings from noteworthy studies carried out previously in this field.

Lyoha (1999) examined the influence of external debt on the economic growth of Sub-Saharan African nations and revealed that external debt negatively impacts investment and does not cause economic growth. However, the findings of Pattillo *et al.* (2003) contended that the effect of debt turns adverse only when it reaches around 160–170 per cent of exports or 35–40 per cent of GDP. Furthermore, they contended that the primary mechanism by which high levels of debt hinder economic growth is through diminishing the productivity of investment rather than its overall magnitude. Yet again, Karagöl (2004) argued that the decrease in investment and economic growth is found in heavily indebted nations which are often linked, to a certain degree, to the magnitude of their external debt. Schclarek (2005) expanded these results by highlighting the crowding-out effect, where high levels of public debt reduce private-sector investments, thereby lowering economic growth.

The study conducted for the period spanning from 1970 to 2003 by Hameed *et al.* (2005) discovered a negative impact of external debt servicing on both labour and capital productivity which creates a barrier to economic growth. Similarly, Shah (2012) investigated the relationship between debt servicing and economic growth in the case of Bangladesh and they found that debt servicing has a negative influence on economic growth. Kasidi and Said (2013) also revealed the detrimental impact of repayment of external debt on the economic growth of Tanzania; they also stated that there is no long-term relationship between external debt and economic growth.

Eberhardt and Presbitero (2015) provided empirical evidence of non-linear relationships between debt and economic growth. In addition, they argued that external debt supports growth up to a certain threshold, beyond which its effects become detrimental due to an increase in debt servicing costs. A study undertaken by Ijirshar

et al. (2016) also found that the repayment of debt negatively affects the economic growth of Nigeria. Gokmenoglu and Rafik (2018) examined the factors influencing Malaysia's external debt. They observed that GDP growth serves as a potential remedy for addressing the issue of external debt.

According to the findings of Jibir *et al.* (2018) an increase in external debt can result in a decrease in economic growth. Mehton and Dhillon (2018) also conducted an empirical analysis to explore the relationship between economic growth, external debt, debt servicing, and exports in India over the period spanning from 1979 to 2014. The Johansen cointegration performed in their study provides evidence in favour of the lack of a long-term relationship.

Using the vector auto regression technique Qureshi and Liaqat (2020) assessed the impact of external debt on economic growth. Their findings also underscored that external debt negatively impacted growth across different income groups, primarily by lowering savings and investments. The Johansen co-integration performed in their study also indicated a lack of long-term relationships. Similarly, Didia and Ayokunle (2020) also stated that there is a negative relationship between external debt and economic growth. They also contended that domestic debt can provide more economic growth benefits compared to external debt in the case of Nigeria because the interest payments on external debt are unable to be reinvested within the nation. Likewise, Zaghdoudi (2020) revealed a statistically significant negative relationship between external debt and economic growth. They also found that external debt had a detrimental effect on economic growth in medium and low-income nations. Shittu *et al.* (2020) examined governance and institutional quality as mediating factors in the debt-growth relationship. They argued that efficient governance can mitigate the adverse effects of debt overhang by ensuring that borrowed resources are utilized productively. Wang *et al.* (2021) also examined the relationship between these variables and yet again they revealed the nexus between high external debt and subsequent decrease in short and long-term economic growth. Mohsin *et al.* (2021) expanded the analysis to South Asian economies, including India, and they also found that high external debt has a negative effect on economic growth. In addition, they contended that effective institutional frameworks and trade openness can reduce the adverse impacts of high external debt and emphasized the need for robust debt management policies in developing economies. Fetuu and Rahman (2022) investigated the influence of external debt on Tonga's economic growth. They also continued to find a negative impact of external debt and debt servicing on economic growth.

Previous studies underscore the detrimental impact of external debt and debt servicing on economic growth in the case of several nations. It is evident from past studies that high debt levels hamper investment and decrease productivity. Although some studies suggest that a certain level of external debt can promote growth, the nonlinear characteristics of this connection are yet to be examined. Furthermore, less focus has been directed toward the dynamic causal links among external debt, debt servicing, and economic growth. This highlights a methodological gap, especially in the utilization of advanced causality techniques, which can yield more profound insights into the directional interdependencies among these variables. Moreover, few studies have examined the causal relationships among these variables within the specific context of India, especially during the post-economic reform era. Hence, this study seeks to fill these gaps, providing a comprehensive examination of causal links and aiding in the formulation of evidence-based debt management policies for India.

3. Methods

The period considered for this study is 30 years, *i.e.*, 1992–1993 to 2021–2022. The variables of this study are External Debt represented as ED, Debt Servicing represented as DS, and Gross Domestic Product represented as GDP hereafter. GDP is considered a proxy for economic growth. The study is based on secondary data collected from the Economic Outlook published by the Centre for Monitoring Indian Economy (CMEI).

In time series analysis, the unit root test is significant for adopting the appropriate econometric model. This

study employs the Augmented Dickey Fuller (ADF) test to check the stationarity of the variables. The mathematical representation of the ADF test can be written as

$$\Delta Y_t = \alpha + \beta_t + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \ldots \delta_{p-1} \Delta Y_{t-p} + \varepsilon_t \ldots (1)$$

where, Δy_t represents the difference of the chosen time series at time t, α symbolizes the interept, β signifies the coefficient of a time trend, the coefficient of the lagged dependent variable term is denoted as y_{t-1}, $\delta_1 \Delta yt_{-1} + \ldots \delta_{p-1} \Delta y_{t-p}$ is the coefficients of lagged difference till p lagged and ε_t represents the error term.

The optimum lag length of the variables used in this study is determined using various criteria such as LR, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQ). Based on the indication by the majority of the criterion the optimal lag length is selected.

After determining the order of integration, the Johansen Co-integration test developed by Johansen (1988) is performed to decide the presence or absence of long-term relationships among the variables. In the absence of a long-run relationship, the Vector Autoregression (VAR) model is selected. Based on the output of the VAR model, the Toda-Yamamoto Granger causality test is employed, which was propounded by Toda and Yamamoto (1995). This test is a technique that involves estimating an augmented or overfitted Vector Auto Regression (VAR) model. This test uses the modified Wald test, and it is suitable regardless of the level of integration or co-integration. This test follows a chi-squared distribution with k degrees of freedom as the estimation of a VAR model of the order $k + dmax$ where k represents the number of lags of the variables, and $dmax$ represents the greatest order of integration for the series (Gharana, 2012). The mathematical equation of the Toda-Yamamoto Causality test performed in this study can be written as:

$$GDP_t = \sum_{i-1}^{P} \alpha_i GDP_{t-i} + \sum_{i-1}^{q} \beta_i ED_{t-i} + \sum_{i-1}^{r} \gamma_i DS_{t-i} + \varepsilon_t \cdots (2)$$

$$ED_t = \sum_{i=1}^{q} \alpha_i ED_{t-i} + \sum_{i=1}^{r} \beta_i DS_{t-i} + \sum_{i=1}^{p} \gamma_i GDP_{t-i} + \varepsilon_t \ldots (3)$$

$$DS_t = \sum_{i=1}^{r} \alpha_i DS_{t-i} + \sum_{i=1}^{q} \beta_i ED_{t-i} + \sum_{i=1}^{p} \gamma_i GDP_{t-i} + \varepsilon_t \cdots (4)$$

where, p is the maximum lag length for GDP, q is the maximum lag length for ED, r represents the maximum lag length for DS, α_i, β_i and γ_i are the coefficients to be estimated and ε_t is the error term at time t.

The required diagnostic tests were performed, including the LM test for serial correlation, the Jarque-Bera test for normality, and the Residual Heteroskedasticity test.

4. Results and Discussion

Selecting the appropriate lag length is a crucial step in order to ensure reliable and significant findings are achieved. Table 1 presents the result of the criteria used for selecting the lag length. The study chose to use 2 lags for subsequent analysis based on the indications provided by the AIC, FPE, LR, and HQ.

The result of the ADF test is shown in Table 2. It is evident from the outcome of the test that all the variables are stationary at first difference. Since all the variables are *I(1)*, it is necessary to examine the existence or lack of a long-term relationship among them. Therefore, the Johansen Cointegration test is performed and the results are presented.

The outcome of the Unrestricted Cointegration Rank Test (Trace) is presented in Table 3. According to the

Table 1. VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-246.7888	NA	95759.88	19.98310	20.12937	20.02367
1	-226.0759	34.79766	37826.30	19.04607	19.63113*	19.20834
2	-211.7884	20.57395*	25733.14*	18.62307*	19.64693	18.90705*
3	-207.1009	5.625076	39987.86	18.96807	20.43072	19.37375
4	-200.2930	6.535544	57979.65	19.14344	21.04489	19.67082
5	-191.7053	6.183151	86841.04	19.17642	21.51666	19.82551
** indicates lag order selected by the criterion*						

Source: Authors' computation.

Table 2. Augmented Dickey-Fuller Test

	t-statistic at I(0)	t-statistic at I(1)
GDP	-3.49	-4.86**
ED	-3.44	-4.33*
DS	-1.76	-6.80*

Note: *, **, indicates significance at 1%, 5%, respectively
Source: Authors' computation.

Table 3. Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.52	41.10	42.91	0.07
At most 1	0.40	20.80	25.87	0.18
At most 2	0.21	6.61	12.51	0.38

Trace test indicates no cointegration at the 0.05 level
Source: Authors' Computation.

Table 4. Unrestricted cointegration rank test (maximum eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.52	20.30	25.82	0.22
At most 1	0.40	14.18	19.38	0.24
At most 2	0.21	6.61	12.51	0.38

The max-eigenvalue test indicates no cointegration at the 0.05 level
Source: Authors' computation.

hypothesized number of cointegration equations, Trace statistic values were generated for different eigenvalues. The eigenvalues were 0.52, 0.40, and 0.21, suggesting no cointegration at r = 0, r = 1, and r = 2, respectively. Calculated Trace statistic values are 41.10, 20.80, and 6.61, respectively, for the Eigenvalues, compared to the critical values at the 0.05 level of significance. The Trace statistic did not exceed the critical value. Thus, the Trace statistic does not support cointegration between variables at 5% significance.

The result of the Unrestricted Cointegration Rank Test Maximum Eigenvalue was carried out, and the results are presented in Table 4. The eigenvalues of 0.52, 0.40, and 0.21 represented situations of no cointegration, at most one cointegration, and most two cointegrations, respectively. The Maximum Eigenvalue statistic values for these eigenvalues were 20.30, 14.18, and 6.61. These values were compared to critical values at a 5% level of significance. The Maximum Eigenvalue statistic values are less than the critical value, disclosing the absence of cointegration between variables at the 5% level of significance.

The results of the Johansen cointegration tests, as presented in Tables 3 and 4, indicate the absence of a long-term equilibrium relationship among external debt, debt servicing, and gross domestic product at the 5% level of significance. Both the Trace and Maximum Eigenvalue tests confirm the lack of cointegration, aligning with the findings of Mehton and Dhillon (2018) and Qureshi and Liaqat (2020), who also reported no evidence of a long-term relationship in similar analyses. This outcome underscores the dynamic and evolving nature of the relationship among these variables in India during the post-reform period, where structural adjustments and policy shifts may have prevented a stable long-term interaction.

Table 5. Block Exogeneity Wald Tests

Dependent variable: GDP			
Excluded	Chi-sq	Df	Prob.
ED	0.420680	2	0.8103
DS	0.139478	2	0.9326
All	0.504357	4	0.9731
Dependent variable: ED			
Excluded	Chi-sq	Df	Prob.
GDP	20.02113	2	0.0000
DS	2.083109	2	0.3529
All	20.31398	4	0.0004
Dependent variable: DS			
Excluded	Chi-sq	Df	Prob.
GDP	6.444891	2	0.0399
ED	3.395939	2	0.1831
All	7.257800	4	0.1229

Source: Authors' computation.

The Block Exogeneity Wald tests reveal important causal dynamics. For GDP as the dependent variable, neither external debt nor debt servicing significantly influences GDP. Thus, there is absence of systematic causal relationship which runs from external debt and debt servicing to economic growth. This outcome diverges from the findings of the past studies, which reported significant adverse effects of external debt and debt servicing on economic growth. The divergence could stem from India's stronger institutional frameworks and diversified growth strategies in the post-reform era, which may have mitigated the immediate impact of external debt and debt servicing on GDP. However, when external debt is the dependent variable, GDP emerges as a significant predictor, suggesting that economic growth drives external borrowing decisions. It also implies that economic growth indicates a nation's stability and potential for further progress which builds a nation's creditworthiness. This aligns with findings such as those by Gokmenoglu and Rafik (2018), where

Table 6. VAR Residual Serial Correlation LM Tests

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	8.757696	9	0.4599	0.991566	(9, 39.1)	0.4626
2	4.395199	9	0.8835	0.472167	(9, 39.1)	0.8843
3	5.979869	9	0.7419	0.654715	(9, 39.1)	0.7436
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	8.757696	9	0.4599	0.991566	(9, 39.1)	0.4626
2	14.34712	18	0.7062	0.772093	(18, 37.3)	0.7169
3	19.09434	27	0.8665	0.629803	(27, 29.8)	0.8857
*Edgeworth expansion corrected likelihood ratio statistic.						

Source: Authors' computation.

Table 7. VAR Residual Normality Tests

Component	Jarque-Bera	df	Prob.
1	4.606427	2	0.0999
2	1.378628	2	0.5019
3	0.806325	2	0.6682
Joint	6.791379	6	0.3406

Source: Authors' computation.

Table 8. VAR residual heteroskedasticity test

Joint test:		
Chi-sq	df	Prob.
66.54527	72	0.6593

Source: Authors' computation.

GDP growth was identified as a key factor in managing external debt levels.

Interestingly, when debt servicing is the dependent variable, GDP shows a significant causal effect. This suggests that India's ability to service its debt is moderately influenced by its economic growth performance. The reasoning behind this trend may be rooted in the post-reform emphasis on export-led growth and foreign capital inflows, which boost foreign exchange reserves and, consequently, debt-servicing capacity.

The implications of these results are significant. The lack of cointegration implies that policy interventions targeting long-term stability among these variables may require more nuanced approaches, considering their lack of inherent equilibrium. The observed causal relationships suggest that while external debt and debt servicing do not directly drive economic growth, the reverse holds true, highlighting the importance of fostering robust GDP growth to sustainably manage external debt and its servicing obligations. These findings call for policies that enhance productivity, strengthen export performance, and ensure that borrowed resources are effectively utilized to sustain economic growth and reduce fiscal vulnerabilities.

In order to assess the adequacy of the model, residual diagnostics are essential. Hence, this study performed necessary diagnostic tests such as tests for serial correlation, normality, and heteroskedasticity. The results of the diagnostic tests are discussed.

Table 6 provides the outcomes of the test for serial correlation, which encompasses both single and multiple lag tests, with a specific emphasis on lags 1 to 3. The null hypothesis of the test states that there is no serial correlation. The findings indicate that the p-values associated with likelihood ratio tests for all lags are significantly high, which means that the null hypothesis is accepted. Hence, the model is free from serial correlation.

The null hypothesis of the Jarque-Bera test assumes that the residuals are normally distributed. The results of the JB test presented in Table 7 show that the p-values for the components as well as for the joint are higher than the 0.05 significance level; hence, the null hypothesis cannot be rejected. This implies that the residuals are normally distributed.

The result of the residual heteroskedasticity test is presented in Table 8. The test joint statistic for residual heteroskedasticity is 66.54527, calculated with 72 degrees of freedom and a p-value of 0.6593 is obtained. This finding implies that there is a lack of substantial evidence supporting the presence of residual heteroskedasticity in the model.

5. Conclusion

This study investigates the causal relationship among external debt, debt servicing, and economic growth in India during the post-reform period using the Toda-Yamamoto causality approach. The findings reveal no long-term equilibrium relationship among

these variables, consistent with past findings. While it was found that external debt and debt servicing do not significantly influence GDP, economic growth is found to drive external borrowing decisions and debt-servicing capacity, emphasizing the importance of sustained economic performance for managing external debt sustainably.

For practitioners, the study underscores the need to prioritize GDP growth through productivity enhancement, export promotion, and effective resource utilization. Strengthening institutional frameworks to ensure the productive use of borrowed funds is essential for mitigating risks of debt overhang.

The limitations of this study include its focus on India, limiting applicability to other larger economies, and the exploration of institutional and structural factors. Future research could address these gaps by studying other economies, incorporating other nonlinear methodologies, and examining governance and trade policies to provide deeper insights into the debt-growth nexus.

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