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Inflation, Economic Growth and External Debt Dynamics: Evidence from Emerging Market Economies

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Abstract

This study aims to examine the dynamic relationships among inflation, economic growth and external debt in eight emerging market economies—Argentina, Brazil, China, India, Indonesia, Mexico, South Africa, and Türkiye—over the period 1990–2023. By employing the Bootstrap Panel Rolling Window Causality Analysis, the study uncovers the time-varying relationships between these variables as well as cross-country differences. The findings indicate that external debt positively influences inflation in Türkiye, while in Brazil, China, India, and South Africa, inflation contributes to the accumulation of external debt. The analysis also reveals that external debt positively contributes to economic growth in Argentina, whereas in Argentina, Brazil, India, Indonesia, Mexico, and Türkiye, economic growth exerts a negative influence on external debt. The results suggest that the effects of external debt on growth can be interpreted within the frameworks of the Debt Overhang Theory and the Growth-Cum-Debt Model. Highlighting the interaction between external debt, debt management, economic structure, and growth dynamics, the study underscores the importance of sustainable strategies and provides meaningful methodological and theoretical contributions to the literature.

Keywords: Inflation, Economic Growth, External Debt, Emerging Market Economies.

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1. INTRODUCTION

The effective design of economic policies and the achievement of designated fiscal and social objectives in a country necessitate a thorough analysis of the interrelationships among macroeconomic variables. Indeed, fundamental economic variables such as external debt, economic growth, and inflation play a critical role in shaping global economic policies and ensuring sustainable development.

This study aims to empirically investigate the bilateral interactions among three key economic variables—economic growth, inflation, and external debt—the direction of these relationships, and their evolution over time, regardless of a country's level of development. To this end, the study employs the Bootstrap Panel Rolling Window Causality Analysis to explore the time-varying bilateral relationships among these economic variables across eight emerging market economies. Various panel causality tests can be utilized in panel data analyses in the literature. However, this study adopts the Bootstrap Panel Rolling Window Causality technique. Compared to other causality methods, this technique allows for the identification of latent causal relationships between variables across different periods, which may not be detected when analyzing the entire time span as a whole. Building on this methodological advantage, the novelty of this study lies in its use of the Bootstrap Panel Rolling Window Causality method to uncover the dynamic and time-varying causal interactions among inflation, economic growth, and external debt across emerging market economies. Unlike previous studies that assume stable causal relationships over time, this approach allows for detecting hidden causality patterns across sub-periods and country-specific differences. Therefore, the study contributes to the literature by providing a more flexible and time-sensitive framework for understanding macroeconomic interactions in developing contexts.

The countries subjected to econometric analysis in this study comprise eight emerging market economies: Argentina, Brazil, China, India, Indonesia, Mexico, South Africa, and Türkiye. A common characteristic of these countries is their classification as emerging market economies by the International Monetary Fund (IMF). The selection of these countries is based on their significant economic growth over the past two decades, positioning them among the world's leading economies. Additionally, external debt is frequently utilized as a financing tool to support economic growth in these countries. However, excessive borrowing and inflationary pressures constitute major risks that threaten macroeconomic stability. It is also important to acknowledge that the panel countries analyzed in this study do not exhibit a homogeneous structure in terms of economic size, inflation, external debt levels, governance systems, population, geographic distribution, and other factors.

This study not only analyzes the potential stimulative effects of external debt on economic growth and the limitations of this relationship but also comprehensively evaluates the role of inflation in external debt accumulation. The findings contribute not only to academic discussions but also provide crucial insights for policymakers in formulating sustainable debt management strategies.

2. THEORETICAL BACKGROUND

The interaction between external debt, inflation, and economic growth has been extensively examined in the literature, grounded in several established theoretical frameworks. The impact of inflation on external debt is typically analyzed through mechanisms such as real debt burden, interest rates, and trade balances, while economic growth is evaluated from the standpoint of debt sustainability and fiscal dynamics.

One of the key effects of inflation is its potential to reduce the real value of debt (Fischer & Modigliani, 1978). For fixed-interest external debt, although the nominal value remains constant, inflation decreases its real burden, easing debt repayment for borrowing countries (Feldstein, 1986). Consequently, inflation can lower the real interest rate paid by governments, thereby decreasing the debt-to-GDP ratio (Escolano, 2010). However, in open economies with free capital mobility, persistent inflation may trigger capital outflows and speculative attacks on the domestic currency. Such dynamics can lead to sharp exchange rate depreciation, increasing the local currency cost of foreign-denominated debt. This mechanism forms a vicious cycle where inflation indirectly raises the real burden of external debt, undermining macroeconomic stability (Gelos et al., 2024). Despite some short-term advantages, inflation may ultimately increase borrowing costs by heightening macroeconomic risks and damaging investor confidence (Reinhart et al., 2015).

According to the Fisher Hypothesis, rising inflation expectations elevate nominal interest rates (Mishkin, 1992), making external borrowing more expensive—especially under variable-rate debt. In addition to increasing financing costs, high inflation may also devalue local currencies, amplifying debt repayment burdens (Ahmed et al., 2021). In highly import-dependent economies, this scenario may exacerbate external vulnerabilities. Dornbusch et al. (1988) highlighted that inflation-induced currency crises significantly increase external debt servicing costs in developing countries.

Governments in high-inflation environments often raise taxes or borrow more to offset declining revenues, which may in turn increase debt burdens. Within the framework of the Debt Overhang Theory, Krugman (1988) posited that excessive debt coupled with inflationary responses may prove ineffective when debt reaches unsustainable levels. Additionally, inflation erodes export competitiveness, reducing earnings needed for external debt repayment (Gylfason, 1999; Piermartini, 2004). Export-led strategies may thus become fragile in inflationary conditions.

High inflation also undermines investor confidence, often interpreted as a signal of policy instability (Wagas et al., 2015). This perception can hinder access to external financing or increase its cost. Some countries resort to monetary expansion to reduce the real value of debt, but this approach risks triggering hyperinflation and long-term economic damage. Historical cases include France under John Law, Weimar Germany, and Zimbabwe (Turner, 2013).

The influence of inflation on external debt is highly context-dependent, shaped by a country's structural characteristics, debt portfolio, and access to international markets. While inflation may reduce the real debt burden in theory, its adverse effects on macroeconomic stability and financing costs often outweigh these benefits.

In contrast, economic growth plays a pivotal role in maintaining debt sustainability. The Debt Sustainability Theory argues that when growth outpaces the interest rate on debt, the external debt-to-GDP ratio stabilizes or declines (Domar, 1944). Strong growth can boost repayment capacity and reduce the debt burden (Afonso & Alves, 2014). However, the Debt Burden Theory cautions that excessive debt can hamper growth by crowding out productive investment (Krugman et al., 1989).

From a savings perspective, economic expansion typically raises national savings, reducing dependency on foreign borrowing. Modigliani and Brumberg's life-cycle hypothesis supports this view, suggesting that higher income leads to greater savings (Deaton, 2012). Nevertheless, growth must be channeled into productive investments to effectively curb external borrowing needs (Schmidt-Hebbel et al., 1994).

Growth also enhances tax revenues, strengthening fiscal capacity to service debt. Keynesian theory holds that progressive taxation during growth periods increases government revenues (Chen, 2019). Similarly, stable growth fosters investor confidence, improving access to global capital markets (Gelos et al., 2011). Yet this confidence is sustainable only if growth is persistent and debt remains manageable.

Sachs (1987) conceptualized the "Growth-Cum-Debt" Model, which emphasizes that export-led growth can support debt repayment by generating foreign exchange. However, the efficacy of this approach depends on whether debt is used for productive investments. The Intertemporal Borrowing Model further argues that expected future income underpins current borrowing decisions; growth can stabilize debt dynamics if it exceeds borrowing costs (Pattillo et al., 2004).

Ultimately, while growth can ease debt sustainability through various channels, its effectiveness diminishes at high debt levels. The interplay between debt and growth must therefore be evaluated in light of each country’s economic structure and policy environment.

3. LITERATURE REVIEW

The relationship between external debt, economic growth, and inflation has been a frequently discussed topic in economic and fiscal literature, analyzed from various dimensions. This includes examining how external debt affects economic growth, its interaction with inflation, and its simultaneous effects on both variables. In particular, whether external debt serves as a growth-promoting tool or a hindrance has been analyzed within the frameworks of debt sustainability levels and economic structures. Similarly, questions about whether high debt levels lead to inflationary pressures have also been central to these discussions.

Some studies have analyzed these variables independently, while others have examined the simultaneous effects of external debt on economic growth and inflation. Table 1 summarizes studies addressing the relationship between external debt and economic growth, the impact of external debt on inflation, and their concurrent effects on both variables. The table includes details about the countries and years analyzed, the methodologies employed, and the findings obtained.

Table 1. Empirical Evidence

External Debt and Inflation Relationship			
Author(s)	**Country (Years)**	**Method**	**Findings**
Karakaplan (2009)	121 countries with varying levels of development (1960–2004)	Causality Analysis Based on GMM Estimation	External debt affects inflation, but in developed market economies inflation is less affected by external debt.
Assibey-Yeboah et al. (2016)	6 Developing Countries (1970–2004)	VAR-PVAR	Inflation shocks lead to a decrease in real output and consumption, while also reducing external debt stocks.
Mweni et al. (2016)	Kenya (1972–2012)	Time Series Analysis - OLS Regression Analysis	External debt increases inflation.
Aimola and Odhiambo (2021)	Ghana (1983–2018)	OLS-VAR-VECM	Public debt increases inflation.
Buyrukoğlu and Canbolat (2023)	Türkiye (2006:Q1 - 2023:Q1)	VAR Analysis and Granger Causality Test	There is a causal relationship between public external debt stock and inflation.
External Debt and Economic Growth Relationship			
Author(s)	**Country (Years)**	**Method**	**Findings**
Chowdhury (1994)	7 developing countries in Asia and the Pacific (1970–1988)	Granger Causality Test	There is a bidirectional causal relationship between external debt and economic growth.
Bilginoğlu and Aysu (2008)	Türkiye (1968-2005)	Ordinary Least Squares (OLS)	Total external debt stock has a negative effect on national income.
Uysal et al. (2009)	Türkiye (1965-2007)	Granger Causality Test	External debt affects economic growth negatively in the short and long run.
Çiçek et al. (2010)	Türkiye (1990Q1-2009Q3)	Johansen Cointegration Test and Granger Causality Analysis	National income is positively affected by domestic debt stock and negatively by external debt stock.
Afonso and Alves (2014)	14 European Countries (1970-2012)	Panel Data Analysis (Hausman Test-2SLS)	Public debt has a negative impact on economic growth.
Gürdal and Yavuz (2015)	Türkiye (1990:Q1 - 2013:Q4)	Gregory-Hansen Cointegration and Hacker and Hatemi-J Causality Test	There is a cointegrated relationship between external debt and economic growth as well as a unidirectional causal relationship from economic growth to external debt.
Erataş and Nur (2015)	10 Emerging Market Economies (1990–2011)	Panel Data Analysis - Westerlund ECM	External debt has a negative impact on economic growth.
Kutlu and Yurttagüler (2016)	Türkiye (1998:Q1 - 2014:Q2)	Granger Causality Test	There is a unidirectional causal relationship from external debt to economic growth.
Kharusi and Ada (2018)	Oman (1990–2015)	ARDL Cointegration and ECM	External debt has a negative impact on economic growth.
Çapık and Kösekahyaoğlu (2019)	Türkiye (1985-2018)	Johansen Cointegration Test and Granger Causality Analysis Based on the TYDL Approach	There is no causal relationship between economic growth and external debt stock.
Biçer (2020)	Türkiye (1970-2017)	ARDL	There is a long-run negative relationship between external debt and economic growth.
External Debt, Economic Growth and Inflation Relationship			
Author(s)	**Country (Years)**	**Method**	**Findings**
Ulusoy and Küçükkale (1996)	Türkiye (1950-1992)	Granger Causality Test	External debt affects economic growth negatively and inflation positively.
Akan and Kanca (2015)	Türkiye (1980-2013)	Granger Causality Test Using the VAR Model	There is a unidirectional causal relationship from economic growth to inflation and external borrowing.

(Table 1 cont.)

Kamacı (2016)	6 Central Asian Republics (1995–2014)	Pedroni Cointegration Test - Panel Granger Causality Test	While there is a unidirectional causal relationship from external debt to growth, there is no causal relationship from external debt to inflation.
Lopes da Veiga et al. (2016)	52 African Countries (1950–2012)	Panel Data Analysis	Public debt has a negative effect on economic growth and a positive effect on inflation.
Çetin (2019)	Brazil, Russia, India, South Africa, Türkiye (1970–2016)	Panel GMM EGLS Method, and Panel Quantile Regression Analysis	External debt positively and significantly affects inflation rates, while economic growth negatively and significantly impacts inflation rates.
Evans (2022)	Ghana (1991–2021)	Johansen Cointegration Test and OLS	External debt has a positive effect on economic growth.
Umit and Dağdemir (2023)	12 Emerging Market Economies (1995–2020)	Panel Data Analysis	External debt affects economic growth negatively and inflation positively.
Ali et al. (2023)	Pakistan (1981-2020)	ARDL	External debt and inflation have a negative impact on economic growth.
Bangara (2024)	Malawi (1984–2020)	ARDL and ECM	Public debt affects economic growth negatively.

When Table 1 is examined, it becomes evident that the relationships between external debt, economic growth, and inflation exhibit complex dynamics, shaped by countries' economic structures, debt management capacities, and prevailing conditions. The literature generally indicates that external debt has a positive impact on inflation; however, this effect varies depending on the level of development of a country's financial markets. Similarly, the effect of external debt on economic growth is predominantly negative, especially when debt levels exceed sustainability thresholds, adversely impacting growth. Nonetheless, under specific conditions, external debt can contribute to growth if it is utilized to finance productive investments. This diversity highlights that the effects of external debt differ depending on a country's economic dynamics, policy preferences, and global economic conditions. Overall, the literature on the effects of external debt on inflation and economic growth does not lead to a uniform conclusion but emphasizes the need to address the topic comprehensively and contextually. Building on this general observation, recent empirical studies further explore the nuances of this relationship by distinguishing country contexts, methodological frameworks, and causality directions, as summarized below.

A wide body of empirical research has explored the relationship between external debt and macroeconomic indicators such as inflation and economic growth. While some studies report that external debt impedes growth due to debt overhang and fiscal pressure (e.g., Krugman, 1988; Reinhart & Rogoff, 2010), others find a positive impact in countries where borrowed funds are channeled into productive investment (e.g., Cohen, 1993; Panizza & Presbitero, 2014). Similarly, the link between external debt and inflation varies across studies, depending on the exchange rate regime, capital flow dynamics, and institutional quality. However, a common limitation in many of these studies is the reliance on static panel or time series methodologies, which do not capture the evolving nature of causality across time and countries. By employing the Bootstrap Panel Rolling Window Causality approach, this study contributes to the literature by offering a temporally flexible and country-sensitive

framework to understand how inflation, growth, and external debt interact over time in emerging market economies.

4. DATA AND RESEARCH METHODOLOGY

4.1. Data

The study conducts an econometric analysis of eight emerging market economies (Argentina, Brazil, China, India, Indonesia, Mexico, South Africa, and Türkiye), which are classified as emerging market economies by the International Monetary Fund (IMF). The time-varying effects of the relationship between economic growth, inflation, and external debt are analyzed using the Bootstrap Panel Rolling Window causality test. The study covers the period from 1990 to 2023. The choice of 1990 as the starting point for the analysis is based on the availability of a common dataset for the panel countries under investigation.

In the study, the share of total external debt stock in GDP is used as an indicator of external debt, the annual growth rate of GDP represents economic growth, and the annual percentage change in the GDP deflator is taken as the inflation indicator. For robustness testing, the crude oil price index is employed as an indicator of external shocks. External shocks can affect national economies directly, indirectly, or simultaneously. Indeed, the economic slowdown of one country may negatively impact the trade and capital movements of another. This situation can lead to a rise in global commodity prices and inflation, thereby indirectly affecting national economies (Şen & Kaya, 2018). The study utilizes an annual dataset for the variables, and the data employed in the analysis are sourced from the World Bank and Economy Watch databases.

4.2. Research Methodology

In the sample of countries analyzed in this study, neglecting cross-sectional dependence can lead to biased analysis results. Therefore, before investigating causality relationships among the variables, it is necessary to test for cross-sectional dependence in the estimation model. To achieve this, the Lagrange Multiplier (LM) test, developed by Breusch and Pagan (1980), is used as a pioneering method to examine cross-sectional dependence. This test becomes more reliable when the time dimension (T) is smaller than the cross-sectional dimension (N). The formulation of the LM test statistic is presented in Equation (1):

$$LM = \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} T_{ij} \hat{p}_{ij}^2 \quad (1)$$

The null hypothesis H_0 of the LM test states that "there is no correlation among residuals." The LM test statistic follows a X^0 distribution with n (n-1)/2 degrees of freedom. However, when the cross-sectional dimension (N) is larger than the time dimension (T), the LM test statistic may not be valid. In

such cases, the scaled version of the test statistic proposed by Pesaran (2004) can be used. The test statistic is presented in Equation (2):

$$LM_s = \sqrt{\frac{1}{N(N-1)}} \Sigma_{i=1}^{N-1} \Sigma_{j=i+1}^{N} (T_{ij} \hat{p}_{ij}^2 - 1) \quad (2)$$

The scaled version of the Pesaran (2004) test statistic, denoted as LM_sfollows a N(0,1) distribution under the null hypothesis. However, when N is relatively larger than T, both LM and LM may exhibit significant size distortions. To address this, Pesaran (2004) developed an alternative test statistic, presented in Equation (3), where the null hypothesis H_0 states that "there is no correlation among residuals.":

$$CD = \sqrt{\frac{2}{N(N-1)}} \Sigma_{J=i+1}^{N-1} T_{ij} \hat{p}_{ij}^2 \; CD = \sqrt{\frac{2}{N(N-1)}} \Sigma_{J=i+1}^{N-1} T_{ij} \hat{p}_{ij}^2 \quad (3)$$

The CD test statistic developed by Pesaran (2004) has an asymptotic standard distribution. However, in cases where individual means differ from zero while the group mean is zero, the CD test statistic loses power and may produce biased results. To address this issue, Pesaran (2004) proposed a bias-corrected LM test statistic. The bias-corrected LM test statistic LM_{adj}assumes the null hypothesis H_0 which states that there is no cross-sectional dependence. The formulation of the test statistic is presented in Equation (4):

$$LM_{adj} = \sqrt{\frac{2T}{N(N-1)}} \Sigma_{i=1}^{N-1} \Sigma_{j=i+1}^{N} \hat{p}_{ij} \frac{(T-k)\hat{p}_{ij} - \mu_{Tij}}{\sqrt{u_{Tij}^2}} \quad (4)$$

LM_{adj} statistic follows an asymptotic standard normal distribution as T→∞ and N→∞. The null hypothesis H_0 for the test statistic is expressed as "there is no correlation among units."

Through the Bootstrap Panel Rolling Window causality method developed by Balcilar et al. (2010), the direction and magnitude of the bilateral relationship between economic growth, inflation, and external debt in the panel countries included in the study were first analyzed using the Bootstrap Panel Granger causality method developed by Kónya (2006). Subsequently, the causality relationship within sub-samples was identified using the Bootstrap Panel Rolling Window approach. In other words, the primary objective of all these econometric tests is to reveal both the bilateral relationship between economic growth, inflation, and external debt for the entire panel and the time-based causality relationship over different periods.

The Bootstrap Panel Granger causality test developed by Kónya (2006) has several unique features: it does not require pre-tests such as unit root or cointegration, is based on seemingly unrelated regression (SUR) estimation that accounts for cross-sectional dependence, and does not require a common hypothesis for the entire sample since it uses Bootstrap critical values calculated for each unit individually based on Wald statistics. While applying this test, it is not necessary for the series in panel

data analysis to be stationary or cointegrated. To implement the Kónya (2006) panel Bootstrap causality test in the study, the equations for Model I and Model II, estimated using Zellner's (1962) SUR estimator, are presented below (Kónya, 2006):

Model I:

$$Debt_{1,t} = \alpha_{1,1} + \sum_{i=1}^{IDebt_1} \beta_{1,1,j} Debt_{1,t-j} + \sum_{i=1}^{IInflation_1} \gamma_{1,1,j} Inflation_{1,t-j} + \varepsilon_{1,1,t}$$

$$Debt_{2,t} = \alpha_{1,2} + \sum_{i=1}^{IDebt_1} \beta_{1,2,j} Debt_{2,t-j} + \sum_{i=1}^{IInflation_1} \gamma_{1,2,j} Inflation_{2,t-j} + \varepsilon_{1,2,t} \quad (5)$$

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$$Debt_{N,t} = \alpha_{1,N} + \sum_{i=1}^{IDebt_1} \beta_{1,N,j} Debt_{N,t-j} + \sum_{i=1}^{IInflation_1} \gamma_{1,N,j} Inflation_{N,t-j} + \varepsilon_{1,N,t}$$

And

$$Inflation_{1,t} = \alpha_{2,1} + \sum_{i=1}^{IDebt_1} \beta_{2,1,j} Debt_{1,t-j} + \sum_{i=1}^{IInflation_1} \gamma_{2,1,j} Inflation_{1,t-j} + \varepsilon_{2,1,t}$$

$$Inflation_{2,t} = \alpha_{2,2} + \sum_{i=1}^{IDebt_1} \beta_{2,2,j} Debt_{2,t-j} + \sum_{i=1}^{IInflation_1} \gamma_{2,2,j} Inflation_{2,t-j} + \varepsilon_{2,2,t} \quad (6)$$

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$$Inflation_{N,t} = \alpha_{2,N} + \sum_{i=1}^{IDebt_1} \beta_{2,N,j} Debt_{N,t-j} + \sum_{i=1}^{IInflation_1} \gamma_{2,N,j} Inflation_{N,t-j} + \varepsilon_{2,N,t}$$

Model II:

$$Debt_{1,t} = \alpha_{1,1} + \sum_{i=1}^{IDebt_1} \beta_{1,1,j} Debt_{1,t-j} + \sum_{i=1}^{IGrowth_1} \gamma_{1,1,j} Growth_{1,t-j} + \varepsilon_{1,1,t}$$

$$Debt_{2,t} = \alpha_{1,2} + \sum_{i=1}^{IDebt_1} \beta_{1,2,j} Debt_{2,t-j} + \sum_{i=1}^{IGrowth_1} \gamma_{1,2,j} Growth_{2,t-j} + \varepsilon_{1,2,t} \quad (7)$$

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$$Debt_{N,t} = \alpha_{1,N} + \sum_{i=1}^{IDebt_1} \beta_{1,N,j} Debt_{N,t-j} + \sum_{i=1}^{IGrowth_1} \gamma_{1,N,j} Growth_{N,t-j} + \varepsilon_{1,N,t}$$

And

$$Growth_{1,t} = \alpha_{2,1} + \sum_{i=1}^{IDebt_1} \beta_{2,1,j} Debt_{1,t-j} + \sum_{i=1}^{IGrowth_1} \gamma_{2,1,j} Growth_{1,t-j} + \varepsilon_{2,1,t}$$

$$Growth_{2,t} = \alpha_{2,2} + \Sigma_{i=1}^{IDebt_1} \beta_{2,2,j} Debt_{2,t-j} + \Sigma_{i=1}^{IGrowth_1} \gamma_{2,2,j} Growth_{2,t-j} + \varepsilon_{2,2,t} \quad (8)$$

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$$Growth_{N,t} = \alpha_{2,N} + \Sigma_{i=1}^{IDebt_1} \beta_{2,N,j} Debt_{N,t-j} + \Sigma_{i=1}^{IGrowth_1} \gamma_{2,N,j} Growth_{N,t-j} + \varepsilon_{2,N,t}$$

In the models, *I* represents the lag length determined using the Akaike Information Criterion. Since the Kónya (2006) Bootstrap Panel Granger causality test only presents results for the entire sample, causality relationships were investigated for rolling sub-samples (by years) t= τ -1+I, τ -1, τ = I, I +1,…..T using the bootstrap panel causality method. Here, *I* represents the fixed size of each year. The control of small-sample bias, along with critical values and p-values, was achieved through bootstrap simulations.

5. EMPIRICAL FINDINGS

In the study, the empirical findings begin with the cross-sectional dependence test, followed by the results of the bootstrap panel causality test. The results of the cross-sectional dependence test are presented in Table 2. The test statistics for LM,LM_s , CD and LM_{adj} which indicate cross-sectional dependence, demonstrate that the null hypothesis of "no cross-sectional dependence" is rejected at the 1% significance level for the panel countries analyzed in the study.

Table 2. Results of Cross-Sectional Dependence Tests

Test Statistic	Model I	Model II
LM	97.903***	343.986***
$\overline{LM_s}$	7.98***	6.47***
CD	9.341***	17.203***
$\overline{LM_{adj}}$	2.859***	7.455***

Note: (***), It expresses statistical significance at 1% level.

The empirical findings presented in Table 2, indicating the presence of cross-sectional dependence among the panel countries, confirm the applicability of the bootstrap panel causality test. Within this framework, the results of the causal relationship between external debt and inflation are shown in Table 3, while Table 4 presents the results of the causal relationship between external debt and economic growth.

Table 3. Empirical Results on External Debt and Inflation

H_0= External debt does not cause inflation.					
Countries	**Coefficient**	**Wald Stc.**	**Bootstrap Crit. Val.**		
			%1	**%5**	**%10**
Argentina	-0.241	0.002	8.061	4.571	3.406
Brazil	-0.280	2.722	8.010	4.210	3.121
China	-0.039	0.333	5.894	3.257	2.259
India	0.055	1.117	17.763	7.495	4.998
Indonesia	0.068	0.280	7.493	4.508	2.981
Mexico	-0.045	2.262	14.133	8.533	6.583
South Africa	-0.002	0.016	13.315	8.019	5.432
Türkiye	0.595	3.253*	6.572	3.767	2.713
H_0= Inflation does not cause external debt.					
Countries	**Coefficient**	**Wald Stc.**	**Bootstrap Crit. Val.**		
			%1	**%5**	**%10**
Argentina	-0.001	0.563	6.750	3.242	2.130
Brazil	0.110	5.337**	9.028	4.869	3.360
China	0.443	21.397***	10.916	7.742	6.279
India	1.419	171.061***	112.999	4.534	2.944
Indonesia	-0.028	0.123	4.473	2.562	1.789
Mexico	-0.158	0.421	11.189	7.928	6.364
South Africa	2.030	24.761***	8.107	4.794	3.321
Türkiye	-0.019	0.651	6.151	3.373	2.499

Note: (***), (**), (*) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The upper section of Table 3 presents the findings for testing the hypothesis that "external debt does not cause inflation," while the lower section shows the results for the reverse relationship. The null hypothesis of "external debt does not cause inflation" is rejected at the 10% significance level only for Türkiye. In Türkiye, external debt has a statistically significant and positive effect on inflation, meaning that as external debt increases, inflation also rises. On the other hand, no causal relationship from external debt to inflation was identified for the remaining seven emerging market economies: Argentina, Brazil, China, India, Indonesia, Mexico, and South Africa. As seen in Table 3, the null hypothesis of "inflation does not cause external debt" is not rejected at the 5% and 1% significance levels for Brazil, China, India, and South Africa. This indicates a positive causal relationship from inflation to external debt in these four countries, meaning that as inflation increases, external debt also rises. However, no causal relationship from inflation to external debt was found for Argentina, Indonesia, Mexico, and Türkiye.

Table 4. Empirical Results on External Debt and Economic Growth

H_0= External debt does not cause economic growth.					
Countries	**Coefficient**	**Wald Stc.**	**Bootstrap Crit. Val.**		
			%1	**%5**	**%10**
Argentina	0.052	6.180*	12.251	7.254	5.133
Brazil	0.010	0.086	10.977	6.217	4.429
China	-0.243	2.832	7.294	4.160	2.973
India	-0.042	0.250	13.428	7.894	5.903
Indonesia	-0.003	0.017	21.399	5.696	3.354
Mexico	0.066	2.605	13.551	6.489	4.840
South Africa	-0.031	2.753	14.070	8.320	5.603
Türkiye	0.164	3.372	13.888	7.481	5.012
H_0= Economic growth does not cause external debt.					
Countries	**Coefficient**	**Wald Stc.**	**Bootstrap Crit. Val.**		
			%1	**%5**	**%10**
Argentina	-1.620	13.423*	12.069	6.388	4.745
Brazil	-1.081	31.669***	6.669	4.108	2.586
China	-0.091	1.131	6.641	3.623	2.463
India	-0.364	15.553***	6.748	3.434	2.223
Indonesia	-4.223	91.471***	26.663	8.871	6.416
Mexico	-1.139	41.052***	10.459	5.970	3.883
South Africa	-0.528	3.875	10.165	5.267	3.798
Türkiye	-0.670	24.802***	8.981	4.968	3.718

Note: (***), (**), (*) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The upper section of Table 4 presents the findings for testing the hypothesis that "external debt does not cause economic growth," while the lower section shows the results for the reverse relationship. The null hypothesis that "external debt does not cause economic growth" is rejected at the 10% significance level for Argentina. In this country, external debt has a statistically significant and positive effect on economic growth, meaning that as external debt increases, economic growth also rises. For the remaining seven emerging market economies (Brazil, China, India, Indonesia, Mexico, South Africa, and Türkiye), no causal relationship was identified from external debt to economic growth. Similarly, the findings for the bilateral causal relationship between economic growth and external debt in the same table show that the null hypothesis, "economic growth does not cause external debt," is rejected at the 10% level for Argentina and at the 1% level for Brazil, India, Indonesia, Mexico, and Türkiye. In these six countries, economic growth has a statistically significant and negative effect on external debt, indicating that as economic growth increases, external debt decreases.

Table 5. Panel Causality Test from Economic Growth and Inflation to External Debt

H_0= Economic growth (Growth) and inflation (Inflation) do not cause external debt (Debt).					
Countries	**Coefficient**	**Wald Stc.**	**Bootstrap Crit. Val.**		
			%1	**%5**	**%10**
Argentina	0.000	1.896	8.040	3.586	2.235
Brazil	0.005	1.493	7.460	3.932	2.895
China	-0.019	2.215	7.029	4.032	3.065
India	-0.102	429.579***	19.846	3.918	2.333
Indonesia	-0.067	88.804***	11.120	6.907	4.754
Mexico	-0.015	0.207	12.658	7.018	5.211
South Africa	-0.138	8.252	20.989	13.768	11.155
Türkiye	-0.011	23.350***	14.325	8.014	5.700

Note: (***), (**), (*) indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The dataset covers the period from 1990 to 2023.

In Table 5, the results of the triple causal relationship among economic growth, inflation, and external shocks are presented. The null hypothesis stating that "economic growth and external shocks do not cause external debt" is rejected at the 1% significance level only for India, Indonesia, and Türkiye. For these countries, a negative causal relationship from economic growth and inflation to external debt is observed. In other words, economic growth and inflation simultaneously trigger external debt. Additionally, in the other five countries examined in the study, no causal relationship from economic growth and inflation to external debt is detected. In other words, in these five countries, no triple causal relationship between economic growth, inflation, and external debt is identified.

Furthermore, a robustness test was conducted to verify the accuracy of the study's findings. As an alternative to inflation, crude oil prices were considered as an indicator of external shocks. As shown in Table 6 (on the following page), a statistically significant and negative relationship from economic growth and external shocks to external debt is identified in India, Indonesia, and Türkiye. However, in the other five panel countries, no significant causal relationship from economic growth and external shocks to external debt is detected. In summary, the findings from the robustness test are consistent with the results obtained from the test where inflation was considered.

However, the results of causality tests can be influenced by countries' internal dynamics such as development levels, economic sizes, trade structures, governance systems, structural and technological changes, and population sizes. In other words, the presence of causal relationships between variables may change over time. For this reason, to capture these unforeseen changes, the study also tests the causal relationships between inflation, economic growth, and external debt by rolling the sample coefficients and analyzing sub-samples. The Bootstrap Rolling Window causality method was used to examine the causality relationships in the sub-samples.

Table 6. Panel Causality Test from Economic Growth and External Shocks to External Debt

H_0= Economic growth (Growth) and external shocks (Shocks) do not cause external debt (Debt).					
Countries	**Coefficient**	**Wald Stc.**	**Bootstrap Crit. Val.**		
			%1	**%5**	**%10**
Argentina	-0.438	10.618	9.960	5.931	4.099
Brazil	-0.002	0.021	7.255	4.171	3.109
China	-0.189	4.303	8.452	5.979	4.855
India	-0.424	12.584***	11.828	5.428	3.455
Indonesia	-0.234	15.525***	9.467	4.154	2.780
Mexico	-0.175	0.171	7.733	4.321	3.135
S. Africa	-0.444	2.492	8.387	4.966	3.275
Türkiye	-5.739	25.358***	8.213	4.509	3.028

Note: (***), (**), (*) indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The dataset covers the period from 1990 to 2023.

The null hypothesis (H_0) in the causality relationship states that there is no Granger causality between the variables. In the Bootstrap Rolling Window causality test method, Bootstrap p-values are aggregated for each sub-sample and compared to the 10% critical value level. If the Bootstrap p-value for any sub-period falls below the 10% critical value, the null hypothesis (H_0) is rejected for that specific sub-period. In this study, the sub-sample size is estimated using the formula $\left[T\left(0.01 + 1.8/\sqrt{T}\right)\right]$, where T represents the time dimension of the model. For a 34-year estimation model, the sub-sample size is calculated as $\left[34\left(0.01 + 1.8/\sqrt{34}\right)\right] = 10.83$, approximately 11 years. The optimal lag length for the sub-sample was determined using the Akaike Information Criterion (AIC).

Since causality relationships may not remain constant over time—particularly during periods of economic instability such as financial crises—analyzing dynamic interactions through moving sub-samples is crucial. In this context, the subsample size determines the number of observations included in each rolling window within the panel dataset. In this study, the time dimension spans 34 years (1990–2023), and the optimal subsample size was calculated as approximately 11 years using the formula $\left[T\left(0.01 + 1.8/\sqrt{T}\right)\right]$ as proposed by Balcilar et al. (2010). This window length represents the temporal scope through which the dynamic relationship between variables is evaluated, allowing for the detection of structural breaks and short-term causal episodes that would otherwise remain hidden in static full-sample models.

Figures 1 and 2 display the p-values of the Bootstrap Rolling Window causality test to determine the causal relationships between external debt size and inflation for each panel country.

When evaluating the results of the Bootstrap Rolling Window causality from external debt to inflation presented in Figure 1, it is observed that there is no causal relationship from external debt to inflation for China and South Africa. These findings align with the Bootstrap panel causality results for these countries. However, in the panel countries analyzed, hidden causality was detected during certain periods for Argentina, Brazil, India, Indonesia, Mexico, South Africa, and Türkiye. In other words, the hypothesis "external debt does not cause inflation" was rejected in Argentina in 2003, 2018, and 2023;

in Brazil in 2010, 2011, 2012, 2013, and 2014; in India in 2001, 2006, and 2023; in Indonesia in 2017; in Mexico in 2007; and in Türkiye in 2006 and 2021. In these countries and years, a causal relationship from external debt to inflation was observed.

Figure 1. Bootstrap Rolling Window Causality Test Results from Debt to Inflation (Bootstrap p-values)

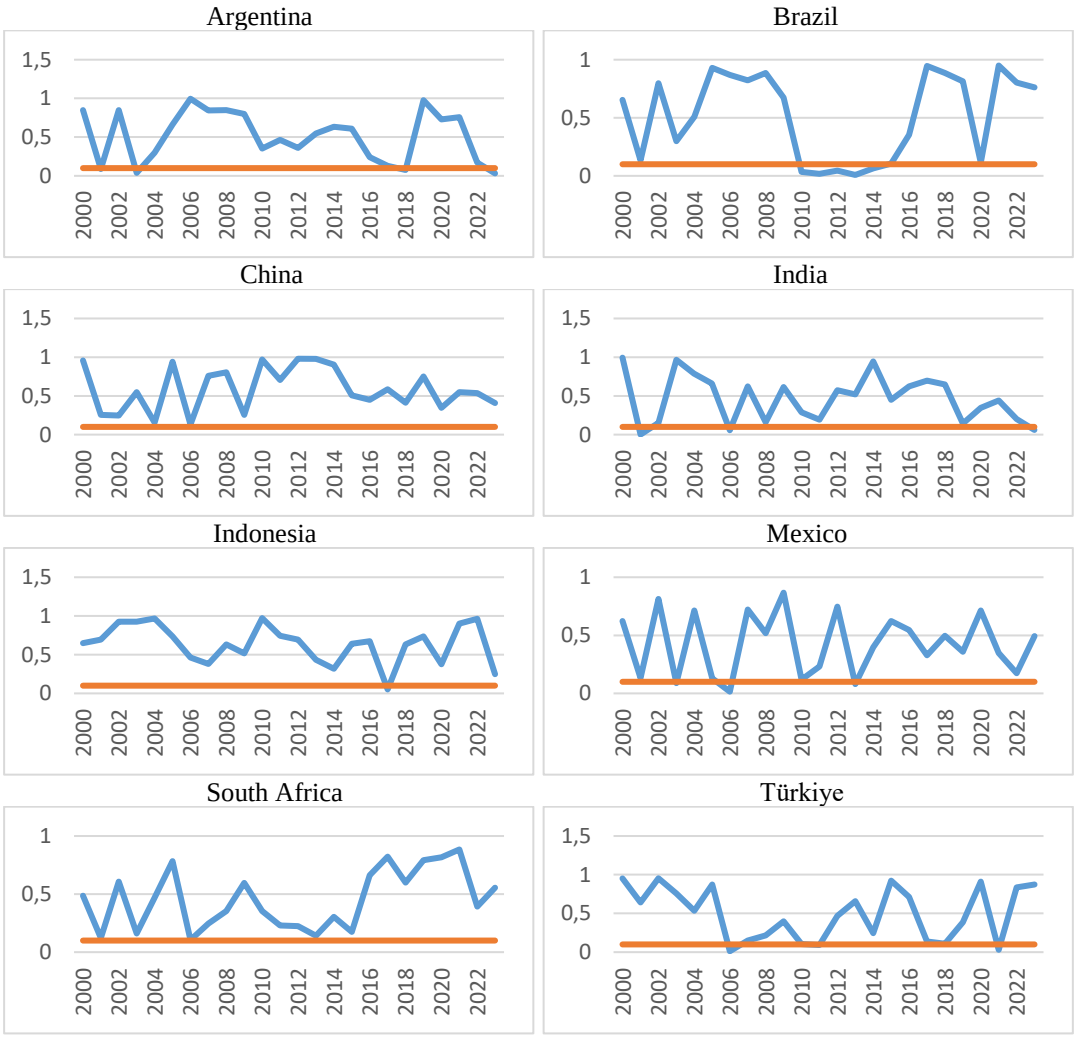
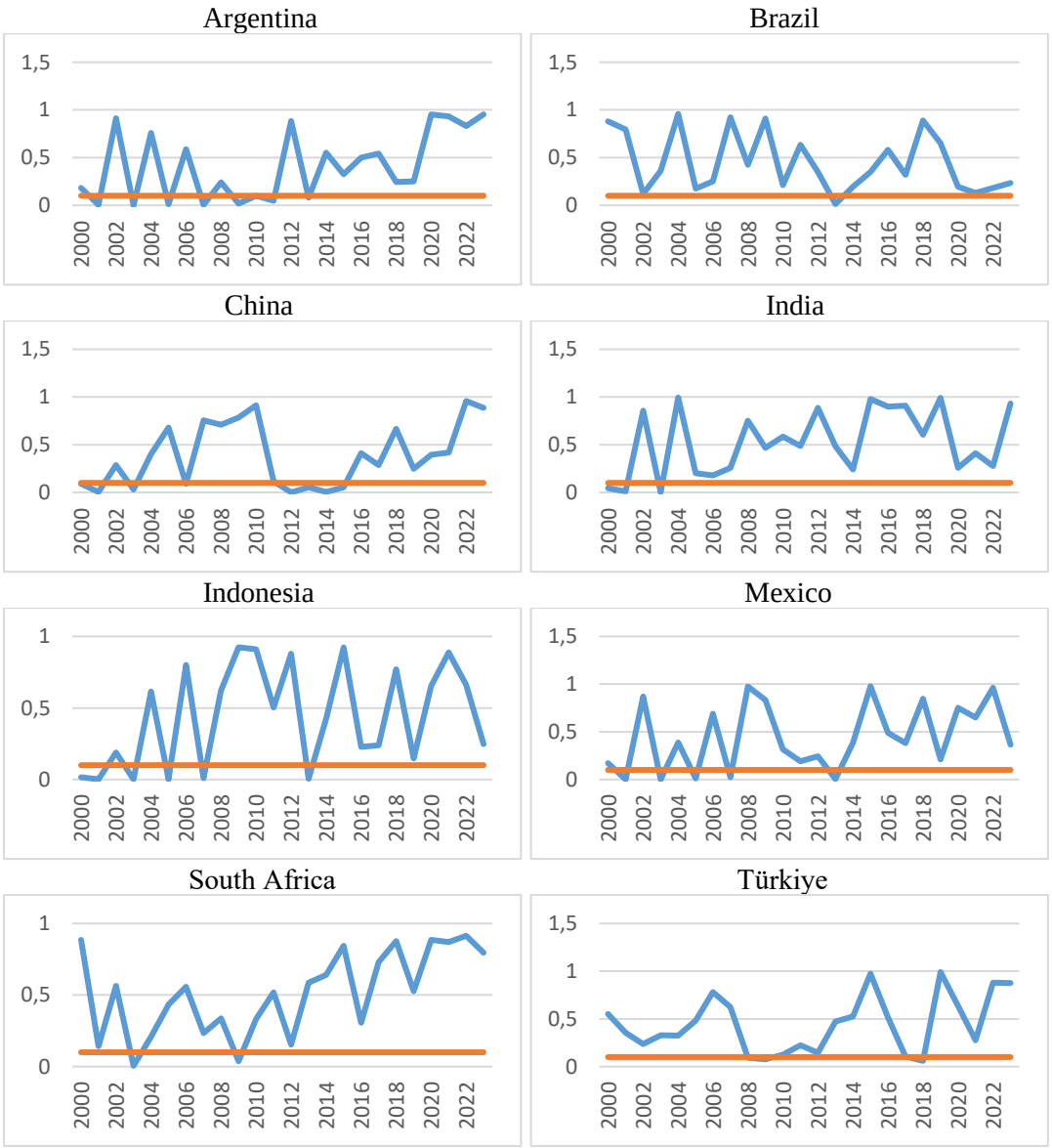


Figure 2 presents the Bootstrap Rolling Window causality findings from inflation to external debt. When the results are evaluated, it is evident that hidden causality is detected during certain periods in all panel countries analyzed. According to the findings, causality from inflation to external debt was observed in Argentina in 2001, 2003, 2005, 2007, 2009, 2011, and 2013; in Brazil in 2013; in China in 2001, 2003, 2012, 2013, 2014, and 2015; in India in 2000, 2001, and 2003; in Indonesia in 2000, 2001, 2003, 2007, and 2013; in Mexico in 2001, 2003, 2005, 2007, and 2013; in South Africa in 2003 and 2009; and in Türkiye in 2009 and 2018.

When Figures 1 and 2 are jointly evaluated, a feedback loop or bidirectional causality relationship between external debt and inflation was identified in Argentina in 2003, Brazil in 2013, India in 2001, and Mexico in 2007.

Some of the bidirectional causality relationships observed in the Rolling Window analysis can be explained by country-specific economic conditions during those periods. In Argentina, the bidirectional causality between external debt and inflation in 2003 can be linked to the aftermath of the 2001–2002 economic crisis, the abandonment of the fixed exchange rate regime, rapid currency depreciation, and the inflationary effects of foreign-denominated debt. For Brazil, the 2013 relationship may reflect vulnerabilities due to volatile capital flows, political instability, import dependence, and a credit-driven growth model. In India, the 2001 bidirectional link is associated with incomplete institutionalization of post-1991 reforms, increased external borrowing, public spending pressures, and vulnerability to global shocks. Mexico's 2007 bidirectional causality may stem from heavy export dependence on the U.S., the impact of the subprime mortgage crisis, and fiscal responses to food price inflation.

Figure 2. Bootstrap Rolling Window Causality Test Results from Inflation to Debt (Bootstrap p-values)



Figures 3 and 4 display the p-values of the Bootstrap Rolling Window causality test for identifying the causality relationships between external debt size and economic growth in each of the panel countries analyzed.

Figure 3 presents the Bootstrap Rolling Window causality findings from external debt to economic growth. The results reveal that, contrary to the findings of the Bootstrap panel causality test, hidden causality exists during certain periods across all eight emerging market economies. Specifically, causality from external debt to economic growth was identified in Argentina in 2006, 2013, and 2022; in Brazil in 2002, 2005, and 2013; in China in 2005, 2006, and 2007; in India in 2013, 2015, 2017, and 2023; in Indonesia in 2009, 2010, and 2019; in Mexico in 2000, 2001, 2005, 2006, and 2019; in South Africa in 2002, 2003, 2006, 2007, and 2013; and in Türkiye in 2004, 2010, and 2011. These findings indicate a causality relationship from external debt to economic growth during these specific years.

Figure 3. Bootstrap Rolling Window Causality Test Results from Debt to Growth (Bootstrap p-values)

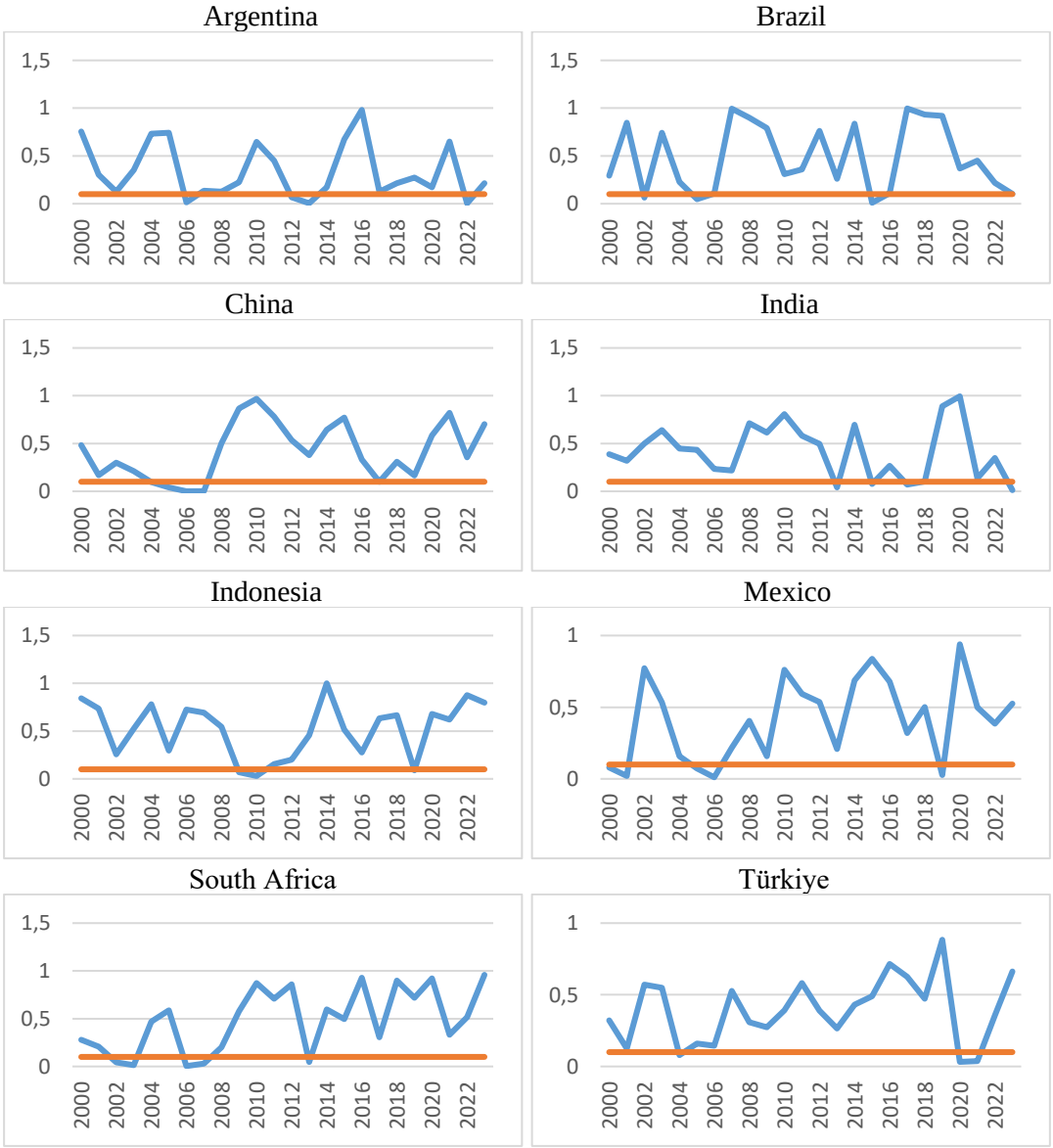
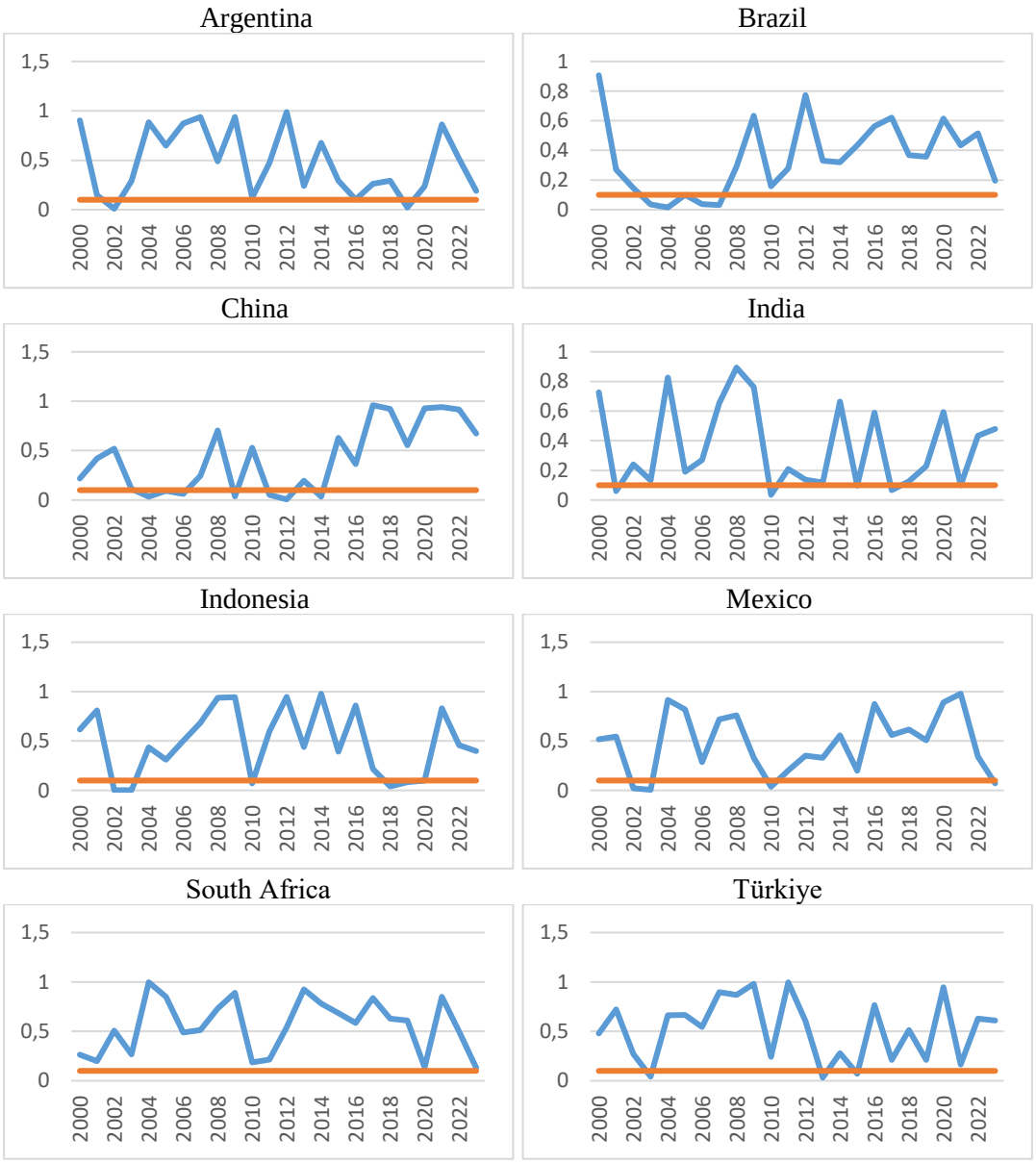


Figure 4. Bootstrap Rolling Window Causality Test Results from Growth to Debt (Bootstrap p-values)



The results indicate that there is no causal relationship from economic growth to external debt only in South Africa. This finding aligns with the Bootstrap panel causality result for this country. Additionally, the findings reveal causality from economic growth to external debt during specific years for other countries: Argentina (2002 and 2019), Brazil (2003, 2004, 2005, and 2006), China (2004, 2006, 2009, 2011, 2012, and 2014), India (2001, 2010, and 2017), Indonesia (2002, 2003, 2010, and 2023), Mexico (2002, 2003, 2010, and 2023), and Turkiye (2003, 2013, and 2015). When Figure 3 and Figure 4 are evaluated together, it is observed that a bidirectional feedback causal relationship exists between external debt and economic growth in Brazil (2005), China (2006), and India (2017).

The bidirectional relationship between debt and growth in China (2006) is tied to an export-led growth model supported by external financing, favorable global liquidity conditions, and infrastructure investments. In Brazil (2005), the link reflects capital inflows driven by improved macroeconomic

indicators and enhanced creditworthiness, enabling both public and private sectors to leverage foreign debt to support growth. In India (2017), the growth-to-debt causality coincides with intensified structural reforms, including digitalization and the introduction of the Goods and Services Tax, which improved investor confidence and led to increased external financing. These interpretations are consistent with prior empirical findings by Reinhart and Rogoff (2010), who emphasize the heightened sensitivity to debt during crisis periods, and Panizza and Presbitero (2014), who argue that the debt-growth nexus is largely context-dependent.

6. CONCLUSION

This study presents significant findings by analyzing the dynamic relationships between inflation, economic growth, and external debt in eight emerging market economies over the period 1990–2023. The analysis, conducted using the Bootstrap Panel Rolling Window causality method, reveals that the relationships among these variables vary over time and differ across countries. These results indicate that the effects of external debt are strongly associated with countries' macroeconomic structures and debt management strategies.

In the case of Türkiye, external debt has been found to have a positive effect on inflation, while in Brazil, China, India, and South Africa, inflation has contributed to the accumulation of external debt. This finding highlights how Türkiye’s borrowing policies influence domestic demand and price dynamics. Specifically, the impact of external debt on the exchange rate increases the cost of imported goods, leading to inflation. For Brazil, China, India, and South Africa, this finding aligns with the notion that high inflation creates macroeconomic instability and increases the cost of external borrowing.

Furthermore, in Argentina, external debt has been observed to contribute positively to economic growth, whereas in many other countries, the relationship between economic growth and external debt is generally negative. This suggests that in Argentina, external debt has been used to finance productive investments, thereby fostering growth. However, in other countries, the negative relationship between growth and external debt implies that when debt reaches unsustainable levels, it may constrain economic expansion. These findings are consistent with theoretical frameworks such as the Debt Overhang Theory and the Growth-Cum-Debt Model, indicating that the impact of external debt on growth should be assessed within these theoretical perspectives. Additionally, it is evident that the effects of external debt on economic growth are shaped by interactions with debt management policies, inflation, and growth dynamics.

The time-varying causality results reveal the need for country-specific macroeconomic strategies. In Argentina, while external debt has in some contexts supported growth, the broader macroeconomic risks underscore the importance of achieving macroeconomic stabilization and strengthening institutional structures. Monetary financing should be abandoned, debt servicing burdens reduced, foreign borrowing directed to productive sectors, and long-term fixed-rate financing preferred.

The experiences of debt-induced inflation in Türkiye during 2006 and 2021 underscore the critical importance of enhancing fiscal discipline and ensuring transparent debt management to prevent similar inflationary pressures in the future. For India, the 2017 growth-to-debt causality suggests increasing domestic savings and channeling debt into productive sectors. Brazil should focus on making public spending more efficient, revisiting subsidies, and ensuring debt supports growth-driving investments. In Mexico, coordinated fiscal-monetary policies, structural reforms, and anti-corruption measures are essential. In China, the bidirectional relationship between debt and growth necessitates prioritizing external debt only for high-yield projects, improving debt efficiency, and supporting growth through domestic demand. These differentiated policy implications demonstrate the necessity of evaluating the debt-growth-inflation nexus within a dynamic and country-specific framework.

The results suggest that directing external debt toward productive investments and maintaining inflation at single-digit levels are critical for economic stability. Long-term investments in infrastructure, education, and healthcare are expected to enhance the contribution of external debt to social welfare. Moreover, the implementation of sustainable debt management strategies is essential to mitigate the adverse effects of external debt and support economic growth. Such strategies would not only promote economic expansion but also strengthen macroeconomic stability.

Ethics Committee approval was not required for this study.

The authors declare that the study was conducted in accordance with research and publication ethics.

The authors confirm that no part of the study was generated, either wholly or in part, using Artificial Intelligence (AI) tools.

The authors declare that there are no financial conflicts of interest involving any institution, organization, or individual associated with this article. Additionally, there are no conflicts of interest among the authors.

The authors declare that they contributed equally to all processes of the research.

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