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Analyzing the Snowball Effect on Public Debt Dynamics and Its Determinants: The Case of North Macedonia

Gjorgji Gockov[1]
Suzana Makreshanska Mladenovska[2]
Goran Hristovski[3]

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Abstract: *Maintaining healthy public finances is essential for financial stability and economic growth. This study examines Macedonian public debt dynamics from 2002 to 2023, focusing on the primary budget balance, the interest-growth differential (snowball effect), and stock-flow adjustments. The snowball effect, where the debt ratio changes based on whether GDP growth surpasses or lags behind interest rates, is emphasized. Recent challenges include sluggish economic growth due to declining external demand and rising food and energy prices, coupled with increasing interest rates, exacerbating the snowball effect. Using the Ordinary Least Squares (OLS) method, the study analyzes how macroeconomic variables like foreign direct investment, trade openness, and unemployment, alongside institutional factors such as government effectiveness and corruption, influence debt dynamics. Policy recommendations stress the need for enhanced fiscal discipline, measures to stimulate economic growth, and improved institutional frameworks to mitigate the adverse effects of the snowball effect on public debt.*

1. INTRODUCTION

Public debt sustainability has gained significant attention in recent years, particularly during and after the 2008 global financial crisis, the COVID-19 pandemic, and the ongoing conflict in Ukraine. The continually growing levels of public debt have become a primary concern, as Debt-to-GDP ratios have surged globally as governments capitalized on historically low interest rates and adopted expansionary fiscal policies during times of crisis. Globally, the Debt-to-GDP ratio has seen significant changes from 2007 to 2023. In 2007, the global average Debt-to-GDP ratio was around 57%. This ratio increased to 97% by 2021 due to various fiscal policies and economic challenges, including the financial crisis and the COVID-19 pandemic (IMF, 2021a). By the end of 2022, the global Debt-to-GDP ratio had reached 238%, indicating a continued upward trend despite efforts to manage debt levels post-pandemic (IMF, 2022). However, in 2023, the global debt stock reached a staggering $307 trillion, with the global Debt-to-GDP ratio stabilizing just below 335% (IFF, 2023). In Europe, the Debt-to-GDP ratio also experienced significant fluctuations. In 2007, the average Debt-to-GDP ratio in the European Union (EU) was 62%. This ratio increased to 90% by 2021 due to various fiscal policies and economic challenges (European Commission, 2021). As of the end of 2022, the Debt-to-GDP ratio in the EU was recorded at 83.4%, showing a slight decrease from the previous year (European Commission, 2022). These statistics underscore the significant fiscal pressures faced by countries worldwide.

[1] Cyril and Methodius University in Skopje, Faculty of Economics-Skopje, Ss. bul. Goce Delcev 9V, 1000, Skopje, Republic of North Macedonia
[2] Cyril and Methodius University in Skopje, Faculty of Economics-Skopje, Ss. bul. Goce Delcev 9V, 1000, Skopje, Republic of North Macedonia
[3] Cyril and Methodius University in Skopje, Faculty of Economics-Skopje, Ss. bul. Goce Delcev 9V, 1000, Skopje, Republic of North Macedonia

In line with this, Macedonia's government debt has followed an intriguing trajectory over the last two decades. In 2008, the government debt was at its historical lowest level, standing at only 20,6% of GDP. Then, over the subsequent 8 years, the debt has doubled, reaching 40,4% of GDP in 2016. Later, the crisis caused by the Covid-19 virus in 2020 had a very profound effect on Macedonia's debt. In just one year, the debt increased by more than 1 billion euros, equal to an increase of over 20 percentage points, reaching 50,8% of GDP in 2020. Finally, the energy crisis intensified by the war in Ukraine in 2022, brought the government debt to its historical highest level of 54,6% of GDP in 2023.

However, the concept of fiscal sustainability indicates that debt-to-GDP ratios cannot grow indefinitely, as this would require continuous tax increases and reductions in government spending on public goods and services. Fiscal sustainability and public debt sustainability are closely related, both referring to a government's ability to meet its debt obligations over the long term (Cottarelli & Moghadan, 2011). According to the International Monetary Fund (IMF), maintaining fiscal sustainability involves ensuring that a government's debt remains on a stable path over time without large adjustments in revenues or expenditures (IMF, 2021b). The World Bank also emphasizes that high and rising public debt can constrain a government's ability to respond to economic shocks and invest in growth-promoting initiatives, ultimately impacting long-term economic stability (World Bank, 2022). Furthermore, Reinhart and Rogoff (2010) argue that when debt levels exceed certain thresholds, economic growth tends to slow down, highlighting the importance of sustainable debt levels for economic health. These perspectives underscore the need for balanced fiscal policies that support economic growth while maintaining debt at manageable levels.

Economic theory identifies three main drivers of public debt accumulation: the primary balance, the snowball effect (interest-rate-growth differential), and deficit-debt adjustments (Boussard et al., 2013; Georgescu, 2014; Heylen et al., 2013). The primary balance reflects the difference between government revenues and expenditures, excluding interest payments. The snowball effect involves the interaction between interest rates and GDP growth, influencing debt dynamics. Deficit-debt adjustments account for factors such as exchange rate fluctuations and stock-flow adjustments.

The "snowball effect" in public debt dynamics refers to the process where the interest rate on debt and the growth rate of the economy interact to influence the overall debt level. When the interest rate on public debt exceeds the economic growth rate, the debt grows exponentially, compounding the burden on the government. Conversely, if the economic growth rate surpasses the interest rate, it helps in stabilizing or even reducing the debt-to-GDP ratio over time (Blanchard, 1990).

In this study, we examine the snowball effect by analyzing the components such as interest rates, GDP growth, and inflation. This involves decomposing the debt dynamics into contributions from the primary balance, interest rate-growth differential (snowball effect), and other factors like deficit-debt adjustments. The period analyzed spans from 2002 to 2023, providing insights into how these components have influenced Macedonia's public debt as well as the main determinants of the snowball effect.

The structure of the paper is organized as follows: Section 2 provides a comprehensive review of the empirical literature on the topic. Section 3 presents an overview of fiscal variables and the economic growth trends in North Macedonia over the past two decades. Section 4 details the data collection process, outlines the methodology employed in the research and presents the results. Finally, Section 5 offers a discussion of the findings, along with concluding remarks and implications for policy and future research.

2. EMPIRICAL LITERATURE REVIEW

Fiscal sustainability refers to a government's ability to maintain sound public finances over the long term without requiring excessive fiscal adjustments. This concept is multi-dimensional, encompassing various academic, policy, and pragmatic approaches. Academically, fiscal sustainability involves inter-temporal solvency, where the initial debt plus the discounted value of future primary expenditures equals the discounted value of future incomes (Blanchard, 1990). The IMF categorizes these definitions into academic, policy, and pragmatic approaches. Policy-wise, debt sustainability implies that a country or its government does not need to default, renegotiate, or restructure its debt, nor make drastic policy adjustments in the future (IMF, 2021b). Pragmatically, public debt is considered sustainable if projected debt ratios are stable or declining and are low enough to avoid default. The European Central Bank defines fiscal sustainability as a government's capacity to service its long-term obligations, which requires solvency, i.e., the ability to repay future debts (ECB, 2012).

Historical perspectives from Buiter (1985), Hamilton and Flavin (1986), and Blanchard (1990) contribute significantly to our understanding of public finance sustainability. Buiter (1985) asserts that fiscal policy is sustainable if the government's net value, in terms of GDP, is maintained. Hamilton and Flavin (1986) empirically test the inter-temporal budget constraint rule, while Blanchard (1990) suggests that sustainable fiscal policy ensures the debt-to-GDP ratio returns to its initial level.

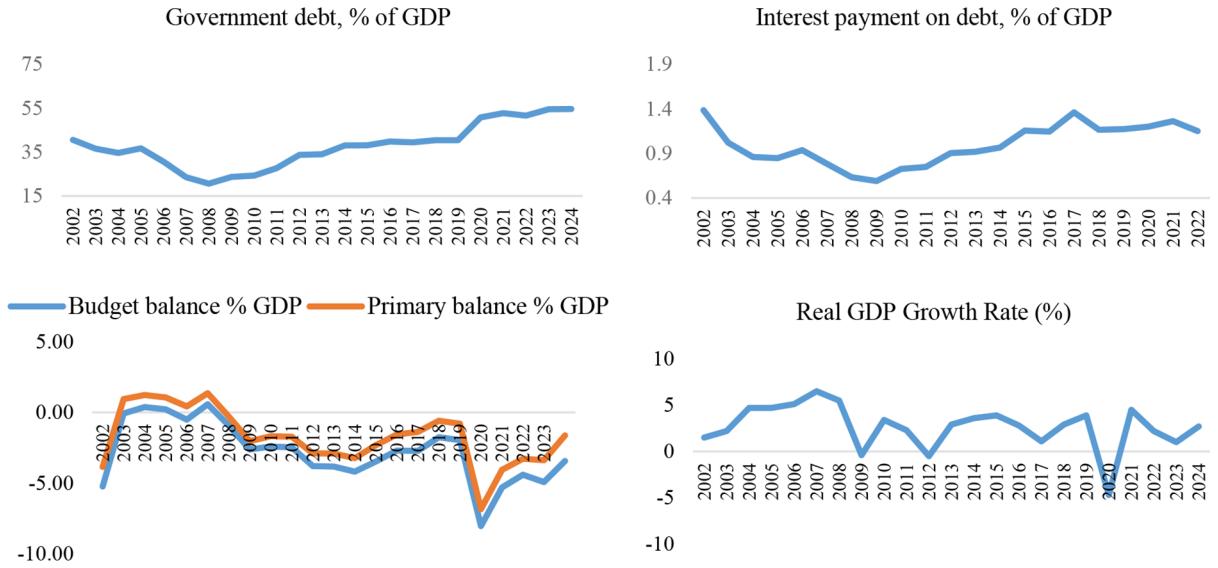
Numerous studies have examined the determinants and implications of public debt. Eichengreen and Portes (1986) find a negative correlation between public debt and economic growth. Sinha et al. (2011) highlight economic growth as a critical determinant of public debt, showing a negative correlation. Hall and Sargent (2011) indicate that economic growth significantly reduced the debt-to-GDP ratio in the United States, with inflation contributing to debt reduction. Aizenman and Marion (2011) demonstrate that moderate inflation can significantly decrease the debt-to-GDP ratio. Bittencourt (2015) emphasizes the importance of economic activity in reducing public debt, showing that a 1% increase in economic growth leads to a 0.7% reduction in public debt. Kudła (2019) investigates the determinants of public indebtedness in European Union countries, emphasizing the role of the snowball effect and specifically analyzing the determinants of the interest-rate-growth differential and changes in government assets.

Additionally, several recent studies have provided further insights into the determinants of the snowball effect on public debt dynamics. Checherita-Westphal (2019) discussed the critical role of the interest-rate-growth differential in government debt dynamics, finding that the differential has turned negative in many advanced economies, which could imply the potential for higher debt sustainability even with primary deficits. Nguyen and Luong (2021) investigated the impact of fiscal policy and institutional quality on public debt in transition countries, demonstrating that improving governance can significantly reduce public debt accumulation. Al Yahya (2019) examined how governance affects public debt accumulation in the Arabian Gulf countries, finding that good governance can reduce borrowing costs and manage financial risk, thereby lowering public debt levels.

These studies collectively provide valuable insights into the factors influencing public debt dynamics and the critical role of the interest-rate-growth differential. They emphasize the importance of understanding these determinants to formulate effective fiscal policies that ensure debt sustainability.

3. GOVERNMENT DEBT INDICATORS – STYLIZED FACTS

The following section briefly analyzes the key fiscal variables and the economic growth in the Republic of North Macedonia over the last two decades. As graph 1. shows, the fiscal variables since 2002 have shown in general adverse trends, particularly during 2008-2016 and from 2020 onward. In particular, the Macedonian government debt has followed a very intriguing trajectory. In the period before the financial crisis, the government debt was decreasing and in 2008 it reached a historically low level of 20.6% of GDP. However, from 2008, within just 8 years, the debt has doubled and exceeded 40% of GDP in 2016. Later, following a brief phase of fiscal consolidation between 2016 and 2020, the COVID-19 pandemic crisis sharply escalated the debt within a year, from 40,4% in 2019 to 50,8% in 2020. Hence, while Macedonia's government debt level (around 54% of GDP in 2024) may not be very high, the rapid acceleration of debt accumulation in recent years is cause for concern.



Graph 1. Fiscal variables and Real GDP growth rate in the Republic of North Macedonia, 2002-2024

Source: Ministry of Finance of the Republic of North Macedonia (n.d.)

The large debt increase naturally led to higher interest payment costs in the analyzed period (the interest cost related to GDP increased from 0,58% in 2009 to 1,36% in 2017), spreading the gap between the primary and overall budget balance, as shown on graph 1.

The primary budget balance, which excludes interest payments, is a key factor in debt accumulation. The primary balance more accurately reflects the present fiscal policy stance by not including interest expenses related to fiscal policy decisions in the previous period. As can be observed from the previously shown debt dynamics, primary surpluses were recorded in the period before the fiscal crisis (peaking at 1.4% of GDP in 2007). However, from 2008 onward, the primary budget balance was consistently in deficit, averaging -2,4 % of GDP.

Economic growth, on the other hand, is a key macroeconomic variable with the most significant impact on the country's public debt sustainability. Higher GDP growth rates, other things being equal, lead to a reduction in the debt-to-GDP ratio and vice versa. In the analyzed period from 2002 to 2023, the economic growth in the Republic of N. Macedonia remained relatively modest, with the real GDP growth rate averaging around 2.7%. Moreover, the second crisis within the

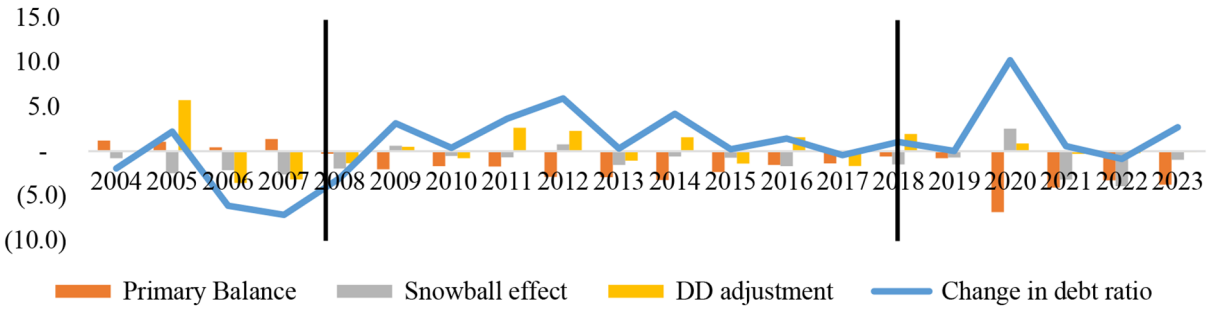
analyzed timeframe, COVID-19 crisis had a more detrimental effect on economic growth, than the financial crisis in 2008 (causing the highest negative real growth rate of -4,5% in 2020). Therefore, we can anticipate that public debt servicing will pose an even greater challenge in the near future.

4. DATA, METHODOLOGY AND RESEARCH RESULTS

4.1. "Snow-Ball" Effect on Public Debt and Its Components

To determine the driving factors of government debt in the Republic of North Macedonia, we performed a conventional dynamic analysis of government debt sustainability. This analysis is based on data from the central government budget and general government debt provided by the Ministry of Finance, GDP and inflation data from the National Bank of the Republic of North Macedonia and the State Statistical Office, covering the period from 2004 to 2023.

Our analysis incorporates the concept of the primary budget balance, calculated as the difference between the actual budget balance and the interest payments on government debt. The annual interest rate on government debt is computed as the ratio of annual interest paid to the government debt outstanding. The GDP deflator is used as an indicator of inflation.



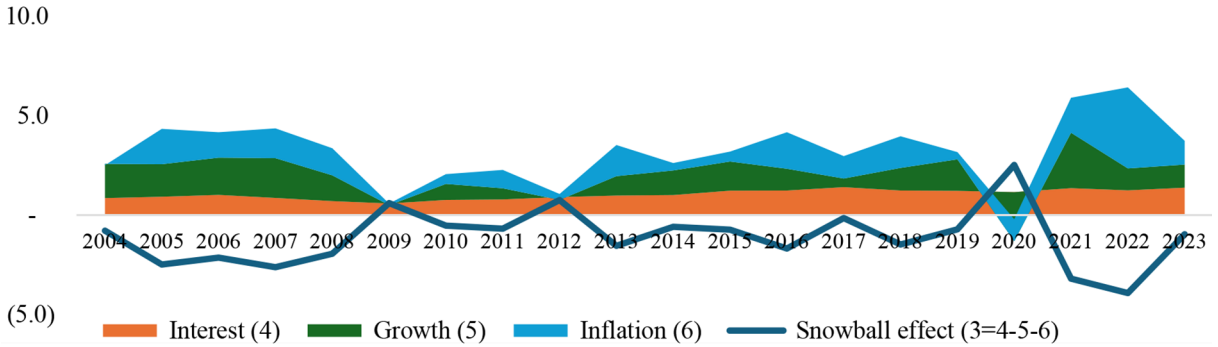
Graph 2. Dynamics of driving factors on public debt

Source: Own calculations based on National Bank of the Republic of North Macedonia (n.d.), State Statistical Office of the Republic of North Macedonia (n.d.), Ministry of Finance of the Republic of North Macedonia (n.d.)

The dynamic analysis of government debt in the Republic of North Macedonia from 2004 to 2023 reveals significant trends and underlying factors influencing debt sustainability, as shown in Graph 2. The graph illustrates persistent primary deficits throughout the period, with notable deficits during the global financial crisis of 2008/09 and the COVID-19 pandemic in 2020. These deficits reflect the government's fiscal policies aimed at stimulating the economy during downturns but have significantly contributed to the overall debt increase. The snowball effect represents the impact of nominal GDP growth and inflation relative to the interest rate on debt. Positive snowball effects (negative values in the graph) indicate periods where economic growth and inflation outpaced interest rates, thereby reducing debt pressures. This effect is particularly noticeable during economic recovery periods such as post-2008 and post-2020, indicating effective debt alleviation during these times. The Debt Dynamics (DD) adjustments show sporadic spikes, indicating sudden fiscal adjustments or policy changes, often reflecting extraordinary fiscal measures or corrections in accounting that impact the overall debt ratio. The overall change in the debt ratio captures the cumulative impact of the primary balance, snowball effect, and DD adjustments. The graph highlights sharp increases in the debt ratio during the 2008/09 financial crisis and the 2020 pandemic, reflecting periods of significant fiscal stress. Despite these challenges, the debt

ratio shows periods of stabilization, particularly in the mid-2010s, and improvement post-2021, suggesting a trend toward economic recovery and enhanced fiscal discipline.

Furthermore, we conduct an in-depth analysis of the components of the "snowball effect". The following graph 3 illustrates how the interest rate effect consistently contributes to the snowball effect, with peaks during economic crises. The growth effect varies, showing significant contributions during economic expansions and negative impacts during downturns. The inflation effect generally provides a stabilizing influence, mitigating some of the interest rate burdens. The snowball effect fluctuates, with spikes during crises, highlighting periods of increased debt burden, while negative values indicate periods where economic growth and inflation help reduce the overall debt burden.



Graph 3. Dynamics of driving factors on "snowball" effect

Source: Own calculations based on National Bank of the Republic of North Macedonia (n.d.), State Statistical Office of the Republic of North Macedonia (n.d.), Ministry of Finance of the Republic of North Macedonia (n.d.)

4.2. Determinants of "Snow-Ball" Effect

To further understand public debt dynamics in North Macedonia, we investigate the determinants of the snowball effect. Our analysis highlights that the snowball effect, characterized by the interest rate-growth differential, is a pivotal factor in shaping public debt sustainability. By systematically examining key macroeconomic and institutional variables, we aim to identify the underlying factors that influence this differential (snow-ball effect).

There is no single answer in the literature to the question of which methodological approach to apply. For example, in a review of the empirical literature we have seen that different studies use different types of statistical techniques, from the simplest least squares method to more complex techniques (separating short-term from long-term dynamics). Hence, the general regression equation for estimating the determinants of the snowball effect can be written as follows:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + ... + \beta_n x_{ni} + \varepsilon_i \quad (1)$$

where, y_i is the dependent variable, which is snowball effect, $x_{1i,} x_{2i}, ... x_{ni}$ are explanatory variables: macroeconomics (FDI, trade openness, unemployment) and institutional (government effectiveness and corruption); β_0, β_1, β_2,... β_n are the parameters to be calculated, and ε_i is the error term that contains other factors that affect the dependent variable and are not included in the independent variables. According to the null conditional mean assumption (Wooldridge, 2006, p. 27), the error term has an expected value of zero if the covariance between it and the independent variables is zero (there is no relationship between the error term and the independent variables).

Table 1. OLS estimation, Results

Dependent Variable: SNOWBALL_EFFECTS			
Independent Variable	Coefficient	Coefficient	Coefficient
	(1)	(2)	(3)
C	17.680*	15.273**	12.908
FDI_GDP	0.091		
TRADE_OPENNES	-0.084*	-0.071**	-0.066*
UNEMPLOYMENT_RATE	-0.340**	-0.299**	-0.258**
GOVERNMENT_EFFECTIVNESS	-7.120*	-7.154*	-6.201
CONTROL_OF_CORRUPTIONS	3.230	2.849	
R-squared	39.92%	38.99%	29.91%

Notes: *, ** and ** indicate rejection of the null hypothesis that the coefficient is not statistically different from zero at 10%, 5%, and 1% significance levels.

Source: Own calculations

The more appropriate method for solving the above equation is the Ordinary Least Squares (OLS) method. This method estimates the coefficients by minimizing the sum of the square deviations between the calculated and the actual values (Gujarati, 2003, p.58). The results are shown in table 1. We employ multiple regressions to get more robust results.

The results of the OLS estimation provide significant insights into the determinants of the interest rate-growth differential effect, commonly referred to as the "snowball" effect. The primary factors under consideration are trade openness, unemployment rate, and government effectiveness. These variables play crucial roles in shaping public debt sustainability by influencing the differential between interest rates on public debt and economic growth rates (snow-ball effect).

Trade openness is found to have a statistically significant negative coefficient across all models, indicating its critical role in mitigating the snowball effect. This relationship suggests that higher levels of trade openness enhance a country's economic growth and external competitiveness. By integrating more fully into the global economy, countries benefit from increased export opportunities, technological spillovers, and greater efficiencies in resource allocation. These benefits collectively contribute to higher growth rates which, in turn, reduce the relative burden of interest rates on public debt. This aligns with existing literature that emphasizes the positive growth effects of trade liberalization and its role in improving fiscal health (Frankel & Romer, 1999). Government effectiveness is another critical determinant, evidenced by its significantly negative coefficient in models (1) and (2). Enhanced government effectiveness reflects better-quality governance, characterized by sound fiscal policies, effective public administration, and minimal corruption. These attributes contribute to an efficient allocation of resources and improved economic management, which are vital for sustaining economic growth and controlling public debt levels. Effective governance ensures that fiscal policies are conducive to growth, thereby reducing the interest rate-growth differential. This relationship is well-documented in the literature, where effective governance is often correlated with favorable economic outcomes and sustainable debt trajectories (Al Yahya, 2019). The unemployment rate exhibits a significantly negative coefficient in all regressions, suggesting an inverse relationship with the snowball effect. Specifically, an increase in the unemployment rate is associated with a reduction in the snowball effect. This means that surprisingly, higher unemployment leads to a smaller differential between interest rates and economic growth rates, which has a positive impact on public debt dynamics. Higher unemployment might lead to lower inflation and interest rates, as central banks may adopt more accommodative monetary policies to stimulate the economy (Blanchard & Summers, 1986). Lower interest rates reduce the cost of servicing public debt, thereby mitigating the snowball effect. Furthermore, lower

economic activity might reduce the need for new borrowing, stabilizing debt levels. In summary, an increase in the unemployment rate, while generally negative for the economy, appears to reduce the snowball effect due to lower interest rates and reduced borrowing needs, leading to a more favorable impact on public debt dynamics. This finding highlights the complex interactions between labor market conditions, monetary policy, and public debt sustainability.

5. CONCLUSION

This study investigated the dynamics of public debt and the determinants of the snowball effect in North Macedonia from 2002 to 2023, providing critical insights into the country's fiscal sustainability. The analysis revealed a significant increase in the debt-to-GDP ratio, which doubled from 20.6% in 2008 to over 50% by 2023, driven by external shocks and domestic fiscal policies. The primary budget balance, excluding interest payments, consistently showed deficits, particularly during economic downturns, significantly contributing to debt accumulation.

The snowball effect, characterized by the interplay between interest rates and GDP growth rates, emerged as a crucial factor in debt dynamics. Positive economic growth and inflation often outpaced interest rates, mitigating some of the debt burden. However, periods of high interest rates and low growth exacerbated debt levels. Key macroeconomic variables, such as trade openness and unemployment rates, significantly influenced the snowball effect. Increased trade openness and unemployment rates positively impacted growth rates, thereby reducing the debt burden relative to GDP. Institutional factors, such as government effectiveness, also played a critical role in shaping debt sustainability. Effective governance contributes to better fiscal management, which in turn leads to lower debt ratios.

The findings underscore the necessity for policies that foster economic growth, enhance trade openness, and improve institutional quality. Strengthening fiscal discipline, controlling primary deficits, and ensuring efficient resource allocation are essential for maintaining public debt sustainability. Additionally, improving trade openness and government effectiveness can significantly impact debt dynamics, ensuring that economic growth translates into sustainable debt levels.

In conclusion, North Macedonia's experience highlights the complex interplay between fiscal policies, economic growth, and institutional quality in managing public debt. By focusing on these areas, policymakers can better navigate the challenges of public debt sustainability, ensuring long-term economic stability and growth. This comprehensive approach is vital for creating a resilient economic environment that can withstand future shocks and maintain fiscal health.

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