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Article

Does growth heterogeneity matter for debt dynamics? Sectoral evidence from an emerging economy

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Abstract: This paper analyzes the drivers of public debt dynamics in Morocco using an accounting-based decomposition of the debt accumulation. The study quantifies the respective contributions of interest costs, economic growth, and the primary balance to changes in the debt-to-GDP ratio, and further decomposes the growth component into agricultural and non-agricultural sources. The results show that debt dynamics are primarily shaped by the interaction between interest payments and the denominator effect of growth, highlighting the dominant role of the interest–growth differential in mechanical debt accumulation. The primary balance emerges as a key policy-driven component, with years of fiscal slippage closely aligned with marked increases in the debt ratio. The sectoral decomposition indicates that the stabilizing effect of growth is structurally anchored in non-agricultural-activity, while agricultural growth is comparatively volatile. This paper provides a policy-oriented application of debt decomposition to a structurally dual emerging economy. By explicitly distinguishing agricultural and non-agricultural growth contributions, the analysis offers additional empirical insights into how growth composition shapes the stability of debt trajectories in climate-sensitive economies. The results suggest that aggregate growth should not be interpreted as a homogeneous stabilizer in dual economies, with important implications for fiscal sustainability assessments in emerging markets.

Keywords: public debt dynamics; debt decomposition and contribution; interest–growth differential; fiscal policy; sectoral growth composition

Classification JEL: H63; E62; O55; O13

1. Introduction

Over the past two decades, public debt ratios have increased sharply worldwide, reaching historically elevated levels in the aftermath of successive global shocks. According to recent IMF (IMF, 2025) estimates, global public debt now stands close to the size of annual world output, reflecting a structural shift rather than a temporary cyclical phenomenon. For lower-income countries, high debt levels interact with limited fiscal space, greater exposure to external volatility, and higher financing costs, thereby intensifying concerns about long-term fiscal sustainability and macroeconomic resilience.

Public debt is fundamentally the outcome of intertemporal fiscal decisions. It can be derived from the government budget constraint, where changes in the debt-to-GDP ratio reflect the combined effects of the primary balance and the interest-growth differential.

Beyond the standard debt decomposition framework, this paper looks at debt from a sector viewpoint. It separates growth into agriculture and non-agriculture. The

goal is to get a picture of what drives overall growth in countries where different sectors affect debt in different ways. This separation is particularly important for Morocco. In Morocco the economy has both an agriculture sector that depends on rainfall and can be very unpredictable and a varied non-agriculture sector. With some economic change Moroccos overall growth still depends on how well its agriculture does. This matters for debt dynamics because fluctuations in GDP growth directly affect the denominator of the debt-to-GDP ratio.

Against this background, this paper examines the drivers of Treasury debt dynamics in Morocco over the period 1990–2024. It decomposes annual changes in the debt-to-GDP ratio into the contributions of the implicit interest rate, nominal economic growth, and the primary balance.

Beyond the standard debt decomposition framework, this paper introduces a sectoral extension that distinguishes between agricultural and non-agricultural growth, with the aim of providing a more granular interpretation of debt dynamics in structurally dual and climate-sensitive economies. This distinction is particularly relevant in the Moroccan context, where the economy exhibits a structural duality: a highly volatile agricultural sector (strongly dependent on rainfall conditions) and a more stable and diversified non-agricultural sector. Despite decades of structural transformation efforts, aggregate growth remains significantly influenced by agricultural performance. This question is particularly relevant in climate-sensitive economies, where sectoral growth fluctuations may reflect not only structural transformation but also recurrent exogenous shocks affecting agricultural output. We therefore ask: Does the sectoral composition of growth matter for public debt dynamics in Morocco?

This paper sits at the intersection of three research conversations—and tries to say something new to each of them. The first is the literature on debt decomposition. Scholars like Escolano (2010) and Mauro et al. (2015) have given us clean frameworks for breaking down debt changes into their component parts. What's been missing, though, is any serious attention to what kind of growth is doing the work. We address that gap by splitting the growth channel into two: the agricultural sector—volatile, rainfall-dependent, unpredictable—and the non-agricultural economy, which behaves very differently. That distinction turns out to matter quite a bit. The second conversation is about climate risk and debt. Buhr et al. (2018) and Klomp (2015) have shown that climate exposure can threaten fiscal sustainability, but mostly through the lens of disasters and long-run vulnerability. Our contribution is more immediate: we show that a bad agricultural year—just one—can flip the debt-to-GDP ratio from improving to worsening, even when everything else holds. That's not a small finding. Third, Morocco itself. Somewhat surprisingly, no one has done a full debt decomposition for Morocco covering more than a few years. We cover 1991 to 2024—over three decades—which makes this the most complete empirical picture of Moroccan Treasury debt dynamics available. Beyond Morocco, the framework should travel well to other MENA economies that share this structural duality between a climate-exposed agricultural base and a more modern non-agricultural sector.

The paper proceeds as follows. Section 2 lays out the theoretical framework. Section 3 walks through what Moroccan debt actually looked like over the study period—the ups, the downs, and the crises that shaped them. Section 4 covers

methodology and data. Section 5 presents the results. Section 6 draws out the policy implications.

2. Theoretical and conceptual framework

2.1. Debt dynamics framework

Public debt dynamics derive from the government's intertemporal budget constraint and can be expressed through the standard debt accumulation equation. In nominal terms:

$$D_t = (1 + i_t)D_{t-1} - p_t \quad (1)$$

where D_t denotes the stock of public debt, it the interest rate, and p_t the primary balance.

Expressed relative to nominal GDP, the evolution of the debt-to-GDP ratio is given by:

$$D_t - D_{t-1} = \frac{(i_t - g_t)}{1+g_t} D_{t-1} - p_t \quad (2)$$

where D_t is the debt-to-GDP ratio, g_t nominal GDP growth, and p_t the primary balance as a ratio to GDP.

This decomposition highlights three fundamental drivers of debt dynamics:

(a) the interest–growth differential ($i_t - g_t$), capturing the snowball effect;

(b) the inherited debt stock D_{t-1}, which amplifies mechanical effects;

(c) the primary balance p_t, reflecting discretionary fiscal policy.

The interest rate–growth differential (the gap between what a government pays to borrow and how fast its economy grows) is one of the most studied concepts in fiscal economics, and for good reason. When growth outpaces borrowing costs (r < g), debt tends to shrink on its own, almost automatically. When it flips the other way, debt becomes a treadmill. Blanchard (2019) and Akyüz (2017) formalized this intuition, but the real debate has been about what happens in practice—and the answers are less reassuring than the textbooks suggest.Recent work has complicated the picture considerably. Mehrotra and Sergeyev (2021) show that the sign and persistence of the r–g differential aren't just accounting matters—they determine whether a country is vulnerable to self-fulfilling debt crises (Moreno, 2022; Mauro, 2021; Eberhardt, 2015). In other words, a persistently unfavorable differential doesn't just slow fiscal consolidation; it can actively destabilize it. For emerging economies, Lian et al. (2020) document that this differential has historically been both more volatile and less favorable than in advanced economies—not because these countries are poorly managed, but because they face higher sovereign risk premia (Lagoa, 2022) and more unstable growth trajectories. That's a structural disadvantage, not a policy failure. Perhaps the most sobering finding comes from Barrett (2018), who shows that the distribution of r–g differentials in developing countries is significantly right-skewed. What that means in plain terms: adverse outcomes—periods when borrowing costs exceed growth—are more frequent than average values would lead you to believe. The average might look tolerable. The tails are where the real risk lives. Morocco fits squarely within this pattern, as the empirical analysis below will confirm.

This accounting framework constitutes the analytical backbone of debt decomposition exercises commonly used in IMF Debt Sustainability Analysis (IMF, 2021). However, it treats economic growth as an aggregate variable, implicitly assuming homogeneous growth dynamics across sectors. The present study relaxes this assumption by explicitly distinguishing between agricultural and non-agricultural growth contributions.

2.2. Fiscal adjustment and debt dynamics

While the debt accumulation identity provides a mechanical decomposition of debt dynamics (Katsikas,2023, Di Domenico,2025), fiscal policy remains the main discretionary channel through which governments can influence the debt trajectory in the short run. In the fiscal sustainability literature, a common benchmark is that higher debt levels tend to be associated with tighter fiscal stances, typically captured through fiscal reaction functions (Bohn, 1998). The present paper does not estimate such behavioral relationships. Instead, the fiscal sustainability framework is used as a conceptual reference to interpret the accounting contribution of the primary balance in the decomposition (Celasun, 2006). In this perspective, the primary balance contribution summarizes the direct policy-driven component of debt dynamics, complementing the mechanical interaction between interest costs, growth, and the inherited debt stock.

2.3. Sectoral growth composition and macroeconomic volatility

In many emerging economies, agriculture remains a significant contributor to economic activity while being highly exposed to climatic variability. Empirical evidence shows that agricultural performance influences aggregate growth but also introduces substantial volatility due to rainfall dependence and climate shocks (Safdar et al., 2012; Inomjonova, 2024). Agricultural growth is therefore often characterized by short-term fluctuations driven by exogenous factors, whereas non-agricultural sectors tend to reflect more persistent structural dynamics (Koren, 2007). As a result, aggregate GDP growth may conceal heterogeneous sectoral processes. Beyond aggregate growth volatility, the literature on climate risk and sovereign debt has increasingly emphasized the role of climate-sensitive sectors in shaping fiscal trajectories. Klomp (2015) shows that natural disasters and climatic shocks significantly increase sovereign default risk in developing economies. Buhr et al. (2018) argue that climate-related output volatility constitutes a structural source of fiscal stress that standard debt sustainability frameworks systematically underestimate. In this perspective, decomposing the growth contribution into climate-exposed and climate-resilient components provides a more accurate characterization of the structural risk embedded in debt dynamics.

This distinction is particularly relevant for debt dynamics (Sogah, 2024; Beha, 2024). Since economic growth enters directly into the debt accumulation equation, differences in sectoral volatility and persistence may affect the stability and interpretation of the growth contribution to debt dynamics. Decomposing growth into agricultural and non-agricultural components allows a more granular analysis of these mechanisms.

2.4. Conceptual model

The conceptual framework presented in **Figure 1** summarizes the analytical structure of the study. It links the standard debt dynamics equation to a sectoral decomposition of economic growth, distinguishing agricultural and non-agricultural contributions within the growth channel.

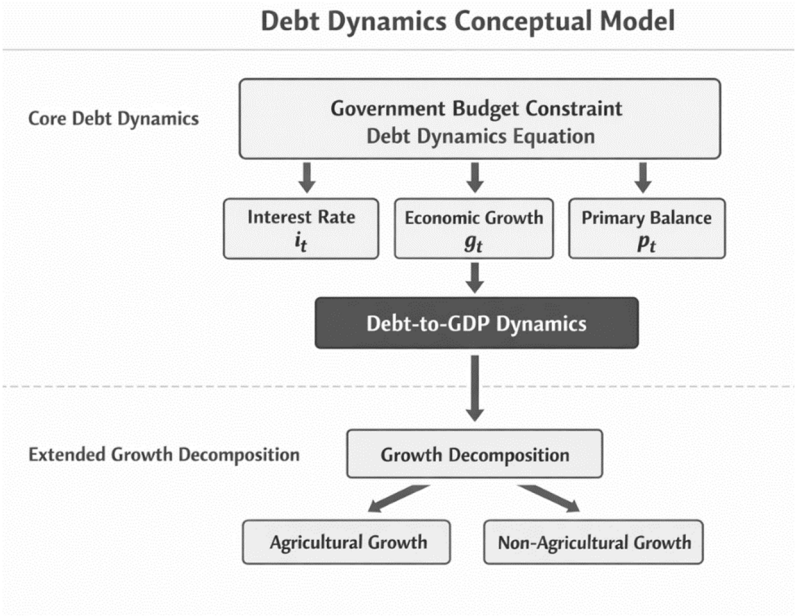

Figure 1. Conceptual Framework of Debt Dynamics in Morocco.

Figure 1 presents the conceptual framework guiding the analytical progression of the paper. The analysis starts from the standard government budget constraint, which provides the theoretical basis for understanding the evolution of the debt-to-GDP ratio. In this baseline step, debt dynamics are explained by the interaction of three core macro-fiscal drivers: the effective interest rate, economic growth, and the primary balance. The empirical strategy first quantifies the respective contribution of each of these components to changes in the debt ratio, thereby establishing the aggregate mechanisms through which fiscal policy, borrowing costs, and macroeconomic conditions jointly shape public debt trajectories.

The framework is then extended by focusing on the composition of economic growth. Specifically, aggregate growth is decomposed into agricultural and non-agricultural components in order to reflect the structural features of dual economies, where sectoral fluctuations may have differentiated implications for fiscal sustainability. This extension allows the analysis to move from aggregate debt dynamics to a more nuanced assessment of how the sources of growth influence the stability of the debt ratio over time.

3. Stylized facts on the evolution of treasury debt in Morocco

A retrospective overview of Morocco's public debt highlights several stylized phases shaped by changing macroeconomic conditions, fiscal policy orientations, and external shocks. Rather than providing a detailed historical narrative, this section

summarizes the main structural patterns relevant for interpreting the debt decomposition results.

Following the macroeconomic imbalances of the late 1970s and early 1980s, Morocco implemented a structural adjustment program supported by the IMF, aimed at restoring fiscal and external stability (Leopardi, 2022). Although fiscal deficits declined substantially during this period, debt levels remained elevated, establishing the starting point of the analysis in the early 1990s.

Figure 2 reports the historical evolution of the gross central government debt-to-GDP ratio in Morocco over the period 1990–2024, establishing the empirical context for the debt dynamics analysis presented in the following section.

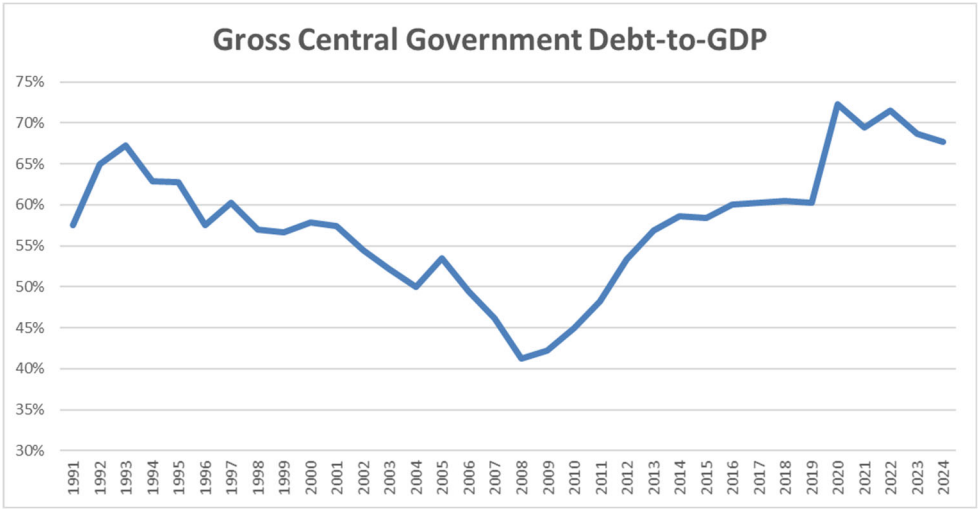

Figure 2. Morocco gross central government debt-to-GDP ratio 1990–2024.

A first phase (1991–2000) corresponds to the gradual restoration of macroeconomic balances and a shift in debt management strategy. Debt reduction remained moderate but persistent, supported by improved debt management practices and a progressive transition toward domestic financing. This period marks the beginning of a long downward trend in the debt ratio.

A second phase (2001–2009) is characterized by stronger economic growth and relatively favorable fiscal conditions. Robust nominal growth and exceptional revenues—notably from privatizations and strong tax performance—contributed to a significant decline in the debt ratio. However, part of this improvement reflected cyclical (Abaida et al, 2024) and non-structural factors rather than permanent fiscal adjustment.

The period 2010–2016 marked a turning point in Morocco's debt trajectory. After several years of decline, the debt ratio began to rise again under the combined pressure of weaker post-crisis conditions, higher commodity prices, and expansionary fiscal policies. In some years, nominal GDP growth was lower than the effective interest rate, allowing the snowball effect to mechanically reinforce debt accumulation.

The following period, 2017–2019, was one of relative stabilization. This reflected both improved macroeconomic conditions and the gradual effects of fiscal reforms, including compensation reform, pension reform, and the implementation of the Organic Finance Law, which limits the use of borrowing to finance ordinary

expenditures (Belcaid, 2022). Lower energy prices also helped reduce fiscal pressures and contributed to stabilizing the debt ratio.

Finally, the years 2020-2024 marked a distinct phase, largely shaped by a series of external shocks. The COVID-19 crisis led to a sharp rise in public debt, driven by sizeable fiscal support measures and a temporary drop in economic activity. The recovery that followed took place amid global inflationary pressures, tighter financing conditions, and repeated climate-related shocks that affected agricultural production. As a result, even though growth recovered, debt levels remained well above their pre-crisis position.

Taken together, these stylized facts reveal that Morocco's debt trajectory alternates between phases dominated by growth-driven debt reduction and episodes of debt accumulation associated with adverse shocks and fiscal expansions. This historical context motivates the decomposition analysis developed in the following sections.

4. Data and methodology

To quantify the relative contribution of each determinant of debt accumulation, the empirical analysis relies on an accounting-based decomposition of the standard debt dynamics equation.

This approach follows the debt decomposition framework widely used in fiscal analysis and Debt Sustainability Assessments. The analysis is purely accounting in nature and does not seek to establish causal or behavioral relationships. Econometric tests of fiscal sustainability, while complementary, fall outside the scope of this paper and are left for future research.

Building on the conceptual framework developed in Section 2, the analysis further extends the standard decomposition by splitting the growth component into agricultural and non-agricultural contributions. The decomposition is implemented both over the full sample period and across five sub-periods, defined later in this section, in order to capture potential structural changes in macroeconomic conditions and fiscal behavior.

4.1. Debt dynamics decomposition

To quantify the relative contribution of each determinant of debt accumulation, the analysis relies on an accounting-based decomposition of the standard debt dynamics equation. Since the change in the debt-to-GDP ratio is defined by an accounting identity, it can be decomposed exactly into additive components reflecting the respective roles of the interest rate, economic growth, and the primary balance.

Starting from the standard debt dynamics **Equation (1)**, the annual variation in the debt-to-GDP ratio can be expressed as:

$$\Delta d_t = \underbrace{\frac{i_t}{1+g_t} d_{t-1}}_{\text{Interest contribution}} - \underbrace{\frac{g_t}{1+g_t} d_{t-1}}_{\text{Growth contribution}} - \underbrace{p_t}_{\text{Primary balance contribution}} + \underbrace{sfa_t}_{\text{Stock-flow adjustment}} \quad (3)$$

$$C_t^{int} = \frac{i_t}{1+g_t} \quad (4)$$

$$C_t^{grow} = -\frac{g_t}{1+g_t}$$

$$C_t^{pb} = -p_t$$

$$sfa_t = \Delta D_t - (C_t^{int} + C_t^{grow} + C_t^{pb})$$

where:

C_t^{int}, C_t^{grow}, C_t^{pb} represent respectively the contributions of the interest rate, nominal GDP growth, and the primary balance.

This decomposition is exact and purely accounting in nature. Its purpose is not to establish causal relationships but to isolate the quantitative contribution of each component to observed debt dynamics.

The stock-flow adjustment (SFA) captures the difference between the change in the debt-to-GDP ratio implied by the accounting identity and the observed change in the reported debt stock. It reflects financing operations that affect the debt level without passing through the primary balance, including asset transactions, exchange rate valuation effects on foreign-currency denominated debt, and off-budget operations. In the Moroccan context, the SFA was particularly significant during the privatization wave of the early 2000s, when asset sale proceeds reduced the effective financing need below the level implied by the primary deficit. Following standard IMF practice (Escolano, 2010), the SFA is reported separately in the decomposition tables.

4.2. Sectoral decomposition of the growth component

The growth term is further decomposed to distinguish between agricultural and non-agricultural sources of economic growth. Aggregate nominal growth is expressed as:

$$g_t = w_{t-1}^{gri} g_t^{agri} + w_{t-1}^{non\ gri} g_t^{non-agri} \quad (5)$$

where w_{t-1}^{gri} and $w_{t-1}^{non\ gri}$ denote the shares of agricultural and non-agricultural GDP in total GDP at time t-1, while g_t^{agri} and $g_t^{non-agri}$ represent nominal growth of the corresponding sectors.

Sectoral shares are measured at period $t-1$ to ensure internal consistency of the growth decomposition, as output growth is defined over the interval between $t-1$ and t.

This extension does not modify the underlying accounting identity but refines the interpretation of the growth channel by distinguishing sectoral contributions characterized by different volatility and persistence patterns. In this perspective, the decomposition can be interpreted as separating relatively volatile growth components from more persistent sources of economic expansion.

4.3. Measurement of contributions

Each contribution is computed annually using observed macro-fiscal variables expressed as ratios to GDP. The decomposition is implemented in percentage-point contributions to changes in the debt-to-GDP ratio, ensuring direct comparability across components and over time.

The interest rate contribution captures the mechanical effect of financing costs on inherited debt. The growth contribution reflects the denominator effect generated by nominal GDP expansion, while the primary balance contribution measures the direct impact of fiscal policy on debt accumulation. All contributions sum exactly to the observed annual change in the debt ratio.

4.4. Periodization strategy

Beyond the full-sample analysis, the debt decomposition is implemented over five sub-periods in order to account for potential regime changes in macroeconomic conditions and debt dynamics.

The periodization follows the business-cycle dating proposed by the Moroccan Ministry of Economy and Finance, as established in the study Dating the business cycle of the Moroccan economy (MEF, 2009). This chronology provides an institutional benchmark identifying successive phases of expansion and slowdown in the Moroccan economy (Elguellab and Ezzahid, 2023). To ensure empirical consistency, this classification is complemented by a graphical analysis based on the Hodrick-Prescott (HP) filter (Ahmad, 2022) applied to real GDP series. The HP-filtered trend is used to identify cyclical turning points and to verify the coherence of the selected sub-periods with observed macroeconomic fluctuations.

Combining an institutional business-cycle dating with a statistical filtering approach allows the analysis to capture regime-dependent debt dynamics while limiting arbitrary period selection. The objective of the periodization is analytical rather than econometric, aiming to improve the interpretation of decomposition results across distinct macroeconomic environments.

4.5. Data selection

The data selection follows directly from the debt dynamics framework presented above. Only variables required for the accounting decomposition are retained, ensuring full consistency between the theoretical model and the empirical implementation. **Table 1** reports these variables.

Table 1. Components used in the debt dynamics decomposition.

Component	Definition	Source
Debt-to-GDP ratio	Stock of treasury debt as a ratio to nominal GDP (central government gross debt)	Ministry of Economy and Finance of Morocco (MEF)
Interest rate	Effective nominal interest rate on treasury debt	MEF
Nominal GDP growth	Growth rate of nominal GDP	National Accounts (HCP)
Primary balance	Primary fiscal balance as a share of GDP	Authors' calculation based on MEF DATA
Agricultural growth	Growth rate of agricultural value added	HCP
Non-agricultural growth	Growth rate of non-agricultural value added	HCP

Source: Authors.

The debt variable refers to gross central government debt as reported by the Moroccan Treasury. The primary balance is calculated as total government revenues minus non-interest expenditures, expressed as a share of GDP, based on official fiscal data from the MEF. The effective nominal interest rate corresponds to interest payments made during year t divided by the outstanding debt stock at the end of year $t - 1$, consistent with standard practices recommended by international institutions such as the IMF and the World Bank and as published by MEF.

4.6. Descriptive Statistics

Table 2 reports summary statistics for the variables entering the debt dynamics decomposition. The objective is to provide an overview of their magnitude and volatility prior to the accounting analysis.

Table 2. Decomposition descriptive statistics of debt dynamics components.

Variable	Mean	Std. Dev.	Min	Max
Debt-to-GDP ratio (%)	57.73	7.97	41.2	72.2
Interest rate (%)	5.52	1.44	3.2	7.9
Nominal GDP growth (%)	5.36	4.07	−7.0	12.4
Primary balance (% of GDP)	−0.15	2.28	−4.6	4.5
Agricultural GDP growth (%)	6.09	19.14	−21.3	54.2
Non-agricultural GDP growth (%)	5.44	3.03	−6.9	10.4

Source: Authors' calculations based on MEF and HCP data

The descriptive statistics highlight the strong volatility of agricultural growth compared with non-agricultural activity, supporting the relevance of distinguishing sectoral growth contributions. From this perspective, debt dynamics can be interpreted not only as the outcome of fiscal and financial conditions, but also as the result of the interaction between structurally persistent growth forces and volatility-driven shocks, which may temporarily amplify or dampen the mechanical evolution of the debt ratio.

The next section examines how these differences translate into the accounting contributions of each component to debt dynamics.

5. Result

5.1. Overview of debt dynamics

The analysis first provides a full-sample overview before examining how the relative importance of these drivers evolves across sub-periods and according to the sectoral composition of growth.

Before interpreting the decomposition results, a preliminary distinction is warranted. The observed annual change in the debt-to-GDP ratio can be decomposed into two analytically distinct parts. The first part, referred to as 'endogenous variation', corresponds to the portion of debt dynamics that is mechanically explained by the accounting identity—that is, the combined effect of interest payments, nominal GDP growth and the primary balance on the inherited debt stock. This component captures the structural interplay between financing costs, macroeconomic conditions and fiscal

policy, and constitutes the analytical core of the decomposition. The second part, SFA, captures the residual difference between the observed change in the reported debt stock and the endogenous variation implied by the identity. It reflects financing operations that affect the debt level without passing through the primary balance, as previously explained.

Table 3 highlights the dominant role of macroeconomic factors in shaping debt dynamics. A first stylized fact concerns the interest rate component. This contribution represents the main structural source of debt accumulation, reflecting the mechanical burden associated with servicing inherited debt stocks.

Table 3. Average contributions to debt dynamics (1991–2024).

Component	Average contribution (% points of GDP)
Change in the debt ratio	+0.21%
Endogenous variation	+0.26%
Interest contribution	+3.00%
Growth contribution	−2.90%
Primary balance contribution	+0.16%
Stock-flow adjustment	-0.05%

Source: Authors' calculations

Conversely, economic growth provides a strong counterbalancing effect, with a negative average contribution of similar magnitude. This result suggests that debt dynamics in Morocco are largely growth-driven, with nominal GDP expansion playing an important role in containing debt increases.

The contribution of the primary balance appears comparatively limited on average and slightly positive over the full sample, suggesting that fiscal policy has not systematically acted as a debt-reducing factor. Rather, fiscal policy seems to have played an adjustment role, with alternating phases of consolidation and expansion.

Finally, the decomposition shows that endogenous debt dynamics explain most of the observed variation in the debt ratio, while stock-flow adjustments remain relatively small in magnitude.

The near symmetry between the average interest contribution (+3) and the growth contribution (−2.9) suggests that the snowball effect has been neutralized (Moreno, 2021, ECB, 2023) over the sample period, implying that debt dynamics were driven less by automatic debt accumulation and more by fluctuations in growth and fiscal conditions.

Figure 3 presents the annual decomposition of changes in the Treasury debt ratio in Morocco over the period.

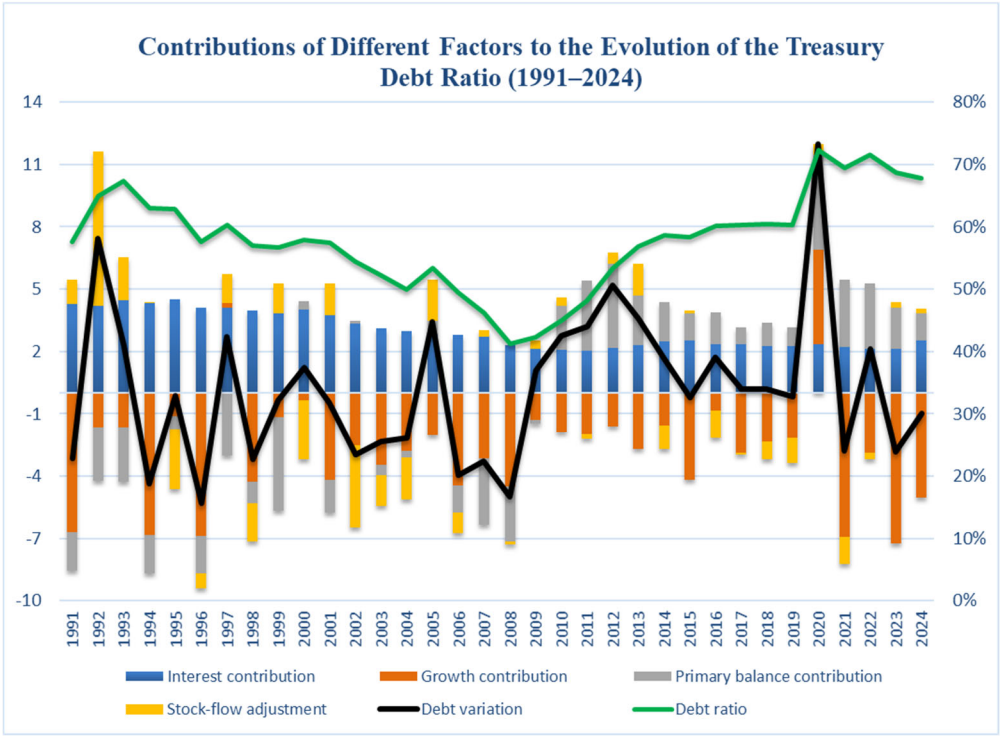

Figure 3. Contributions of Factors to the Evolution of the Treasury Debt Ratio (1991–2024).

5.2. Debt dynamics across sub-periods

Looking at debt over three decades as a single average is useful, but it's also misleading. It smooths over the fact that different forces drove debt in different eras. The 1990s weren't the 2000s, which weren't the crisis years, which weren't the recovery. Interest rates moved. Growth accelerated and stalled. The government tightened and loosened its fiscal belt. Each shift changed which lever was actually moving the debt ratio. To capture these regime-dependent dynamics, the decomposition is examined across five sub-periods reflecting distinct phases of Morocco's macroeconomic trajectory.

Table 4 reports the average contribution of each component to changes in the debt-to-GDP ratio across the selected sub-periods.

Table 4. Average contributions to debt dynamics by sub-periods.

Component	1991–2000	2001–2009	2010–2016	2017–2019	2020–2024
Change in the debt ratio	−0.28%	−1.74%	+2.55%	+0.06%	+1.49%
Endogenous variation	−0.81%	−1.30%	+2.50%	+0.80%	+1.60%
Interest contribution	+4.18%	+2.90%	+2.30%	+2.30%	+2.30%
Growth contribution	−3.04%	−3.20%	−2.10%	−2.50%	−3.50%
Primary balance contribution	−1.94%	−1.00%	+2.40%	+0.90%	+2.90%
Stock-flow adjustment	+0.53%	−0.50%	+0.00%	−0.70%	−0.10%

Source: Authors' calculations.

The picture changes sharply when you look at the components separately across time. A first phase, covering the periods 1991–2000 and 2001–2009, is characterized

by declining debt ratios on average. During these years, the combined contribution of economic growth and primary balances more than offset the positive pressure exerted by interest payments. Although the interest component remained relatively high, robust growth effects and fiscal adjustment contributed to a sustained debt-reducing dynamic.

A clear shift appears from 2010 onward. The 2010–2016 period marks a reversal in debt dynamics, as the theoretical change in the debt ratio becomes positive. This change is mainly driven by the primary balance contribution, which turns positive and therefore adds to debt accumulation. At the same time, the growth contribution, although still negative, becomes less stabilizing than in previous periods. As a result, endogenous debt dynamics move from a debt-reducing regime to a debt-increasing one.

The period 2017–2019 appears as a phase of relative stabilization, with contributions from the main components remaining close to balance. Debt dynamics during these years reflect a temporary equilibrium between financing costs, growth effects, and fiscal policy.

Finally, the period 2020–2024 is dominated by exceptional macroeconomic conditions. Despite a strong debt-reducing contribution from growth, reflecting the rebound following the pandemic shock, the primary balance contribution becomes strongly positive, generating renewed upward pressure on debt dynamics. This suggests that fiscal expansion played an essential role in shaping debt evolution during this recent phase.

Overall, the sub-period analysis highlights that the relative importance of debt drivers is highly regime-dependent. While growth historically acted as a strong stabilizing force, changes in fiscal policy stance and macroeconomic conditions significantly altered the balance of contributions over time.

An important result from the sub-period analysis is that economic growth remains, on average, the main force stabilizing debt across all regimes. However, the size of this contribution varies considerably over time, suggesting that aggregate growth may hide important differences across sectors. This calls for a closer look at the composition of growth, by distinguishing between agricultural and non-agricultural sources.

5.3. Sectoral decomposition of the growth contribution

The previous results suggest that growth plays an important stabilizing role in debt dynamics. However, aggregate growth may combine structurally different sectoral processes, mixing volatile agricultural fluctuations with more persistent non-agricultural expansion. This section therefore decomposes the growth contribution to examine how sectoral composition shapes debt dynamics.

The growth contribution is further decomposed into agricultural and non-agricultural components using sectoral GDP shares. Consistent with the accounting structure of the debt dynamics equation, the contribution of each sector is computed as:

$$C_t^{agri} = \frac{w_{t-1}^{agri} g_t^{agri}}{1+g_t} D_{t-1}, \quad C_t^{non-agri} = \frac{w_{t-1}^{non-agri} g_t^{non-agri}}{1+g_t} D_{t-1} \tag{6}$$

Table 5 reports the decomposition of the growth component of debt dynamics into agricultural and non-agricultural contributions. This decomposition allows identifying the relative importance of each sector in explaining the stabilizing effect of economic growth on the debt-to-GDP ratio.

Table 5. Decomposition of the growth contribution.

Component	Average contribution (% points of GDP)
Contribution of agricultural growth	−0.30%
Contribution of non-agricultural growth	−2.60%
Total growth contribution	−2.90%

Source: Authors' calculations

The results show that the stabilizing effect of economic growth on debt dynamics is overwhelmingly driven by the non-agricultural sector. Out of the total growth contribution of −2.9 points of GDP, non-agricultural growth accounts for approximately 90% of the effect, while agricultural growth contributes only about 10%.

This result is central for interpretation: the debt-stabilizing power of the growth channel in Morocco is structurally concentrated in the non-agricultural sector, whose more persistent expansion dynamics contrast sharply with the climate-driven volatility of agricultural output. This asymmetry reflects the structural composition of the Moroccan economy, where non-agricultural activities represent the dominant share of output and display more persistent growth patterns. By contrast, although agricultural growth can generate significant short-term fluctuations, its average contribution to debt reduction remains comparatively limited.

These findings suggest that agricultural growth, while more volatile, contributes less consistently to debt dynamics, whereas non-agricultural growth constitutes the main structural channel through which economic expansion stabilizes the debt-to-GDP ratio.

The next section therefore extends the analysis by examining the sectoral decomposition across sub-periods in order to assess whether the relative importance of agricultural and non-agricultural growth changes over time.

Table 6 reports the average contribution of agricultural and non-agricultural growth to debt dynamics for each sub-period. This period-based perspective helps distinguish structural patterns from temporary fluctuations linked to specific shocks.

Table 6. Average sectorial decomposition of the growth contribution by sub-periods.

Contribution	1991–2000	2001–2009	2010–2016	2017–2019	2020–2024
Agri growth	−0.26%	−0.42%	−0.14%	−0.37%	−0.35%
Non-agri growth	−2.78%	−2.73%	−1.97%	−2.09%	−3.15%
Total growth	−3.04%	−3.15%	−2.11%	−2.46%	−3.50%

Source: Authors' calculations

The results show that the debt-reducing effect of growth is consistently dominated by the non-agricultural sector across all sub-periods. Non-agricultural growth accounts for the overwhelming majority of the total growth contribution,

reflecting both its structural weight in the Moroccan economy and its relatively stable expansion dynamics. By contrast, the agricultural contribution remains modest in magnitude, varying between −0.14 and −0.42 percentage points of GDP depending on the period.

A clear temporal pattern emerges. During the first two sub-periods, 1991–2000 and 2001–2009, aggregate growth exerts a strong stabilizing effect on debt dynamics, mainly driven by non-agricultural activity. This contribution weakens in 2010–2016, in line with the slowdown in overall growth dynamics, before gaining strength again in the most recent period, 2020–2024, when the role of the non-agricultural sector becomes particularly pronounced.

The agricultural component shows greater variability across sub-periods, but its average magnitude remains limited. This suggests that agricultural growth affects debt dynamics mostly through short-term fluctuations, rather than through persistent structural effects. By contrast, non-agricultural growth provides a more stable and continuous source of debt reduction, confirming its central role in shaping medium-term debt dynamics.

A further asymmetry appears when annual sectoral contributions are examined over the full sample. Excluding the exceptional COVID-19 shock, the non-agricultural component never records a positive contribution to debt dynamics, meaning that it consistently helps reduce the debt ratio. Even in its weakest years, its contribution remains negative, reaching at most around −0.7 percentage points of GDP.

By contrast, the agricultural component exhibits significantly higher volatility and occasionally turns positive, thereby contributing to debt accumulation in certain years. The most pronounced example occurs in 1997, a year marked by a severe agricultural shock in Morocco. Following an exceptionally strong harvest in 1996, adverse climatic conditions led to a sharp decline in agricultural output, causing aggregate GDP to contract despite continued expansion in non-agricultural sectors. In that context, the agricultural contribution reached approximately +2.1 percentage points of GDP, illustrating how negative agricultural shocks can temporarily (1993, 1995, 2014, 2016, 2022) reverse the stabilizing effect of growth and contribute to widening the debt ratio.

This evidence reinforces the interpretation that non-agricultural growth acts as a structurally stable anchor for debt dynamics, whereas agriculture mainly introduces cyclical volatility driven by exogenous climatic shocks.

More broadly, the results suggest that in economies characterized by a sizeable climate-sensitive agricultural sector, the growth channel of debt dynamics cannot be interpreted as uniformly stabilizing, since sectoral composition may temporarily reverse its effect and generate episodes of debt amplification despite positive underlying non-agricultural trends.

Although the analytical framework rests on a deterministic accounting identity—and is therefore not subject to estimation uncertainty in the conventional econometric sense—additional sensitivity checks were conducted in response to the reviewer's concern regarding the stability of the reported decomposition. First, the baseline results were replicated across alternative sub-period definitions to verify that the identified contribution patterns are not an artifact of a particular periodization choice. Second, the decomposition was re-run excluding the COVID-19 episode (2020-2021),

which constitutes an exceptional macroeconomic disturbance likely to distort the structural interpretation of sectoral dynamics. Across both sets of checks, the qualitative findings remain materially unchanged: non-agricultural growth consistently emerges as the dominant stabilizing force in public debt dynamics, while the destabilizing role of agricultural volatility proves equally persistent. These results lend structural robustness to the main conclusions, confirming that they are not sensitive to reasonable variations in the analytical perimeter.

6. Discussion

The results presented above invite a broader reflection on the theoretical and policy implications of growth heterogeneity for debt sustainability analysis. Standard debt sustainability frameworks, including the IMF's Debt Sustainability Analysis, treat aggregate growth as a homogeneous input into the debt equation. The findings of this paper challenge this assumption by showing that, in structurally dual economies, the composition of growth, introduces a structural source of asymmetric risk into debt dynamics that aggregate indicators fail to capture.

This result has direct implications for how fiscal space should be assessed in climate-exposed emerging economies. When a significant share of GDP growth is driven by rainfall-dependent agriculture, the denominator effect of growth is inherently less reliable as a debt stabilizer than aggregate growth rates suggest.

The sectoral decomposition confirms that the stabilizing effect of growth is overwhelmingly driven by non-agricultural activity. Agricultural growth contributes only marginally on average and displays significantly higher volatility. In several years, adverse agricultural shocks temporarily reversed the debt-reducing effect of growth. The episode of 1997 is particularly illustrative: unfavorable climatic conditions sharply reduced agricultural output and weakened aggregate growth despite continued non-agricultural expansion. This asymmetry underscores that growth composition and persistence, determine the reliability of the denominator effect in debt dynamics.

Alongside growth, fiscal policy plays an essential stabilizing role through the primary balance. Sustained fiscal discipline has contributed to containing debt accumulation, consistent with Morocco's institutional framework. Nevertheless, variations in the primary balance remain among the most influential short-run determinants of debt dynamics: periods of fiscal slippage systematically coincide with significant increases in the debt-to-GDP ratio, confirming that fiscal policy constitutes the main discretionary lever available to counteract adverse macroeconomic conditions.

A key implication of these findings relates to the interaction between fiscal policy and the snowball effect. When the interest-growth differential becomes unfavorable, debt dynamics worsen mechanically, increasing the need for fiscal adjustment. In this context, maintaining a sufficiently strong primary balance becomes essential to offset automatic debt accumulation. Conversely, when economic growth exceeds borrowing costs, the pressure on fiscal adjustment is reduced, allowing debt to stabilize even in the presence of moderate primary deficits. This interaction shows that fiscal discipline

and macroeconomic conditions are closely linked, since it is their combined effect that ultimately shapes the path of public debt.

An important limitation of this approach is that the decomposition is purely accounting-based and therefore does not establish causal relationships. In particular, some of the underlying macro-fiscal variables may be jointly determined over time. For this reason, the reported contributions should be interpreted as quantitative accounting components, rather than as structurally independent causal effects.

Overall, the findings suggest that effective debt management requires a dual approach. Fiscal rules and primary balance adjustments remain essential for limiting debt accumulation in the short run. At the same time, structural transformation toward less volatile and more persistent sources of growth is equally important for achieving sustained debt stabilization over the medium term. In climate-exposed dual economies, reducing dependence on agricultural volatility is therefore not only a development objective, but also a key condition for fiscal sustainability.

An important limitation of this analysis is that the decomposition is accounting-based and does not establish causal relationships. Some of the macro-fiscal variables included in the framework, particularly growth, fiscal balances, and borrowing conditions, may be jointly determined over time. The reported contributions should therefore be interpreted as accounting components that show how each factor is associated with observed changes in the debt ratio, rather than as structurally independent causal effects. Future research could extend this approach through econometric specifications that incorporate explicit climate-risk indicators, such as rainfall variability, in order to better assess the causal transmission between agricultural shocks and debt dynamics.

7. Conclusion

This paper examined the determinants of public debt dynamics in Morocco using an accounting-based decomposition of the standard debt accumulation equation. By separating the contributions of interest costs, economic growth, and the primary balance, and further decomposing growth into agricultural and non-agricultural components, the analysis provides a detailed understanding of the mechanisms shaping changes in the debt-to-GDP ratio over time.

The results highlight three main findings. First, debt dynamics are primarily driven by the interaction between interest rates and economic growth, confirming the main role of the interest-growth differential and the stabilizing effect of growth under favorable macroeconomic conditions. Second, the primary balance acts as an important fiscal stabilizer, although deviations from fiscal discipline are closely associated with significant increases in the debt ratio. Third, the sectoral decomposition shows that the debt-stabilizing effect of growth is mainly driven by non-agricultural activity, while agricultural growth remains more volatile and can occasionally amplify debt dynamics during adverse climatic episodes.

Taken together, these results suggest that debt sustainability in emerging economies depends not only on fiscal discipline and financing conditions, but also on the composition and stability of growth. Policies aimed at strengthening non-agricultural sources of expansion and reducing vulnerability to agricultural shocks

may therefore play an important complementary role in supporting medium-term debt stabilization.

These findings should nevertheless be interpreted with caution, as they are grounded in a single-country accounting framework and cannot be mechanically extended to other emerging economies without due consideration of differences in fiscal institutions, growth structures, and exposure to climatic shocks.

Finally, several extensions of this framework appear promising for future research. First, the integration of explicit climate risk indicators into the debt dynamics equation would allow a more direct quantification of climate-related fiscal risk. Second, a comparative analysis extending the sectoral decomposition to other structurally dual economies in the MENA region or Sub-Saharan Africa would help assess the generalizability of the findings. Third, the potential nonlinear interaction between debt levels, agricultural volatility, and fiscal adjustment responses constitutes an important avenue for econometric investigation, as high-debt environments may amplify the fiscal consequences of agricultural shocks through tighter financing constraints and procyclical fiscal responses.

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