The Threshold Effect of Public Debt on Economic Growth: A Comparative Morocco-South Korea Analysis Using the PSTR Approach

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Abstract. This paper examines the non-linear relationship between public indebtedness and macroeconomic performance in Morocco and South Korea using quarterly data over 1990Q1–2023Q4, with a particular focus on identifying debt thresholds beyond which growth dynamics fundamentally change.A Panel Smooth Transition Regression (PSTR) model is estimated to allow the marginal effect of public debt on real GDP growth to vary smoothly across regimes, with the transition driven by the public debt-to-GDP ratio and controlling for investment, trade openness and fiscal balance.The analysis identifies a unified debt threshold at 56.5% of GDP, marking a critical inflection point in the debt–growth relationship. Contrary to conventional debt overhang predictions, the estimated debt coefficient strengthens in high-indebtedness regimes ($\beta = +0.130$) compared with low-debt environments ($\beta = +0.020$), while elevated debt burdens reduce fiscal multiplier effectiveness by about 32% and turn trade liberalization effects from neutral to contractionary. The estimated smoothness parameter ($\gamma = 0.421$) indicates gradual rather than abrupt regime transitions, providing policymakers with scope for adjustment.The findings challenge universalist threshold frameworks by showing that sustainable debt levels depend critically on institutional quality and the productive use of borrowing, and they provide comparative evidence for an emerging economy and a more advanced economy sharing a common intermediate threshold.

Keywords: Public debt, Economic growth, Threshold effects, Panel Smooth Transition Regression (PSTR), Morocco, South Korea.

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1 Introduction

The nexus between sovereign indebtedness and aggregate economic performance has generated intense debate for decades. Government borrowing can finance infrastructure, education and health, but may also crowd out private investment and undermine long-run growth. Demand-side frameworks emphasise the stabilising role of deficit-financed spending when private demand collapses (Keynes, 1936), whereas supply-side and neoclassical views highlight crowding-out and distortionary taxation (Barro, 1974). The COVID-19 pandemic, which pushed global debt ratios to unprecedented peacetime levels, has turned this long-standing theoretical controversy into an urgent policy question: at what point do rising debt burdens become incompatible with sustainable growth?

Early empirical work typically modelled the debt–growth relationship as linear, implicitly assuming a constant marginal effect of debt irrespective of the initial debt level. Subsequent evidence has shown that this assumption is too restrictive, with systematic non-linearities and context-dependent effects (Fischer, 1993; Égert, 2015). In response, threshold analyses have sought to identify critical debt ratios beyond which growth dynamics change. Reinhart and Rogoff (2010) famously suggested a universal 90% debt-to-GDP threshold for advanced economies, but their result was later challenged on methodological grounds by Herndon et al. (2014), and later work documented substantial heterogeneity, with thresholds ranging from about 30% to above 100%, depending on country samples, institutional quality and empirical methods (Égert, 2015; Chudik et al., 2017; Mbaye et al., 2022; Calvo et al., 2008). The emerging consensus is that there is no single universal safe level of debt; instead, debt tolerance depends on structural and institutional factors.

A major gap in this literature is the limited attention to emerging economies and to how debt thresholds differ across development stages. Emerging markets represent the bulk of the world's population and an increasing share of global output, yet face tighter fiscal and financial constraints. Morocco has maintained an average public debt ratio of around 63.7% of GDP in recent decades, with narrow tax bases, infrastructure needs and institutional constraints that limit fiscal space. By contrast, South Korea rebuilt from post-war devastation into a high-income, technology-intensive economy, sustaining a much lower average debt ratio of about 43.3% of GDP under comparatively strong institutions. Comparing these two trajectories offers a natural laboratory to examine how structural characteristics shape debt tolerance along the development path.

Most previous empirical contributions rely either on linear panel regressions or on discrete threshold models. Linear specifications impose homogeneous effects by construction, while discrete thresholds allow regime shifts but assume abrupt breaks when debt crosses a given cutoff (Hansen, 1999, 2000). Economic transitions are unlikely to be so discontinuous: as debt rises from moderate to high levels, the growth consequences are expected to adjust gradually, not jump at a single point, and mis-specifying this adjustment may lead to misleading notions of "hard" safe limits. The Panel Smooth Transition Regression (PSTR) framework developed by González et al. (2005) relaxes these restrictions by modelling continuous, data-driven transitions

between regimes. It allows the marginal effect of debt on growth to vary smoothly with the debt-to-GDP ratio while exploiting the information content of panel data and accommodating cross-country heterogeneity.

Against this backdrop, the present study addresses three questions. First, do Morocco and South Korea share a common public debt threshold despite their divergent development paths, or do structural differences generate distinct tipping points? Second, how does the debt–growth relationship change across regimes once the threshold is crossed, particularly in terms of the sign and magnitude of debt's marginal effect? Third, how do high debt levels interact with key transmission channelsfiscal multipliers, trade openness and investmentto reshape policy space? Using quarterly data from 1990Q1 to 2023Q4 for both countries and a PSTR specification, the paper uncovers a common threshold around 56.5% of GDP and documents a counterintuitive finding: the direct marginal effect of debt on growth strengthens in the high-debt regime, while fiscal multipliers deteriorate and trade openness turns from neutral to contractionary. These findings have important implications for how emerging and advanced economies alike should interpret debt thresholds and design public debt management strategies.

2 Literature Review

Theoretical perspectives on the growth consequences of public debt have evolved from simple dichotomies to more nuanced, context dependent frameworks. Keynesian demand management views regard sovereign borrowing as a countercyclical tool that sustains aggregate demand, capacity utilisation and public investment when private demand collapses, with fiscal multipliers potentially exceeding one and, in some cases, partly self-financing through higher tax revenues (Krugman, 2009; Aschauer, 1989; DeLong and Summers, 2012; Ramey, 2019). In contrast, neoclassical and Ricardian approaches stress crowding out and distortionary effects: higher public debt may raise interest rates, displace private investment and require future taxation that distorts labour supply and capital allocation, while high indebtedness can also create policy uncertainty that depresses current spending and investment (Barro, 1974; Bernheim, 1987; Seater, 1993; Fischer, 1993; Elmendorf and Mankiw, 1999; Alesina and Perotti, 1997; Bloom, 2009).

Empirical evidence suggests that neither view dominates universally; instead, the debt–growth relationship depends on institutions, financial development and macroeconomic conditions. Institutional quality influences whether borrowed resources finance productive infrastructure and human capital or are dissipated through inefficiency and corruption (Fischer, 1993; Égert, 2015). Emerging markets often suffer from "original sin" and currency mismatches, which raise borrowing costs and vulnerability to sudden stops (Eichengreen et al., 2005), while fiscal multipliers vary with the business cycle, monetary stance and exchange rate regime (Christiano et al., 2011; Ilzetzki et al., 2013). At moderate debt levels, borrowing can support growth by financing productive investment, but as debt accumulates, rising risk premia, crowding out and policy uncertainty may reverse the sign of the relationship, giving rise to threshold effects (Ghosh et al., 2013; Ostry et al., 2010).

Against this backdrop, empirical threshold identification has become a central research theme. Reinhart and Rogoff (2010) argued that growth declines sharply beyond a

90% debt to GDP ratio in advanced economies, a result that influenced post crisis austerity debates, but subsequent reexamination by Herndon et al. (2014) highlighted coding errors and sample choices that undermined the claim of a universal cliff. Later studies confirmed non linearities but reported a wide range of threshold estimatesoften around 80–95% for OECD and euro area countrieswhile more flexible approaches, including PSTR models, emphasized smooth rather than discrete regime shifts (Cecchetti et al., 2011; Checherita and Rother, 2010; Baum et al., 2013; d'Albis et al., 2022).
For emerging economies, thresholds are typically much lower, reflecting "debt intolerance". External debt levels of about 35–40% of GDP have been associated with weaker growth in developing countries, with some heavily indebted poor countries facing problems at ratios as low as 20–25% (Clements et al., 2003; Pattillo et al., 2011). Weaker institutions, limited market depth and foreign currency borrowing make these economies more prone to crises at debt levels that advanced economies can manage, a pattern documented in the "debt intolerance" literature (Reinhart et al., 2003). Meta analyses and recent cross-country work show robust evidence of non-linearities but also substantial heterogeneity: threshold estimates are sensitive to country samples, time periods, and econometric techniques, and institutional quality explains much of the cross-country variation (Égert, 2015; Ahmad et al., 2021).

Despite these advances, three gaps remain salient. First, most studies focus either on advanced or on emerging economies separately, offering limited insight into how debt tolerance evolves along the development path. Second, annual data dominate the literature, which reduces statistical power and obscures short run dynamics relevant for policy timing. Third, while many contributions identify thresholds, fewer investigate the transmission mechanismsthrough fiscal multipliers, trade integration or investmentthat change across debt regimes. This study addresses these gaps by comparing Morocco, a representative emerging market, with South Korea, a country that has recently transitioned to advanced economy status, using a quarterly panel from 1990Q1 to 2023Q4 and a PSTR framework to capture smooth transitions. It documents a common threshold around 56.5% of GDP and shows that, above this level, the direct marginal effect of debt on growth remains positive while fiscal space erodes and trade openness becomes growth reducing, yielding a more nuanced view of debt overhang than simple linear or discrete threshold narratives. This study contributes to the literature by combining high-frequency data, a comparative emerging-advanced economy framework, and a PSTR approach to explore regime-dependent transmission mechanisms.

3 Data and Methodology

3.1 Empirical strategy and model specification

This study examines whether public debt affects economic growth differently across debt regimes in Morocco and South Korea. Standard linear panel regressions impose homogeneous marginal effects, implicitly assuming that an additional point of debt has the same impact when the debt to GDP ratio is 20% or 80%. Discrete threshold models (Hansen, 1999, 2000) relax this assumption but generate abrupt regime shifts: growth coefficients change discontinuously once debt crosses an estimated cutoff, which is at odds with the idea of gradual adjustments in expectations, risk premia and policy responses.

The Panel Smooth Transition Regression (PSTR) model of González et al. (2005) provides a more flexible framework by allowing the coefficients to vary smoothly with a transition variable. In this setting, the debt–growth relationship evolves progressively as public debt accumulates, while the panel structure exploits information from both countries and accommodates unobserved heterogeneity through country specific fixed effects.

The baseline PSTR specification with one transition function is:

$$y_{it} = \alpha_i + \beta'_0 x_{it} + \beta'_1 x_{it} \cdot g(q_{it}; \gamma, c) + \theta' z_{it} + \varepsilon_{it} \quad (1)$$

Where:

- y_{it} : is the dependent variable, the real GDP growth rate for country i*i* in quarter t*t*.
- α_i : represents country-specific fixed effects, controlling for time-invariant heterogeneity between Morocco and South Korea (structural, institutional, or cultural differences).
- x_{it}: is the vector of explanatory variables whose impact is allowed to vary across regimes (in our core specification, this is solely the public debt-to-GDP ratio).
- β_0 : is the coefficient vector in the first extreme regime (low-debt regime).
- β_1 : measures the change in the coefficients when transitioning to the second extreme regime (high-debt regime).
- $g(q_{it}; \gamma, c)$: is the continuous transition function bounded between 0 and 1.
- q_{it}: is the transition variable, which we set as the public debt-to-GDP ratio ($Debt_{it}$) to model regime changes based on debt levels.
- $\gamma > 0$: is the smoothness parameter, determining the speed of the transition between regimes.
- c : is the location parameter, representing the debt threshold around which the transition centers.
- z_{it}: is a vector of control variables with constant coefficients θ.
- ε_{it} : is the idiosyncratic error term, assumed to be $i.i.d$.

The transition function $g(Debt_{it}; \gamma, c)$ is a logistic function of order one:

$$g(Debt_{it}; \gamma, c) = \frac{1}{1+exp(-\gamma(Debt_{it}-c))} \quad (2)$$

This function is monotonically increasing in $Debt_{it}$, bounded between 0 and 1, and symmetric around the threshold c*c*. When $Debt_{it} \ll c$, $g(.) \approx 0$, and the model collapses to the low-debt regime: $y_{it} \approx \alpha_i + \beta'_0 x_{it} + \theta' z_{it}$. Conversely, when $Debt_{it} \gg c$, $g(.) \approx 1$, and the model becomes the high-debt regime: $y_{it} \approx \alpha_i + (\beta_0 + \beta_1)' x_{it} + \theta' z_{it}$. For intermediate values, the model is a weighted average of the two regimes, elegantly capturing the smooth transition.

Our specific empirical model is thus:

$$Growth_{it} = \alpha_i + \beta_0 Debt_{it} + \beta_1 Debt_{it} \cdot g(Debt_{it}; \gamma, c) + \theta_1 Investment_{it} + \theta_2 TradeOpenness_{it} + \theta_3 FiscalBalance_{it} + \varepsilon_{it} \quad (3)$$

The marginal effect of public debt on economic growth is therefore not constant but given by a continuously varying function:

$$\frac{\partial Growth_{it}}{\partial Deb_{it}} = \beta_0 + \beta_1 \cdot g(Debt_{it}; \gamma, c) + \beta 1 \cdot Debt_{it} \cdot \frac{\partial g(Debt_{it}; \gamma, c)}{\partial Debt_{it}} \quad (4)$$

This allows us to trace out the precise non-linear impact of debt on growth across its entire observed distribution.

3.2 Variable construction and data sources

The analysis uses a balanced quarterly panel for Morocco and South Korea from 1990Q1 to 2023Q4, yielding 272 observations (136 per country). Morocco and South Korea provide a contrasting development trajectory while sharing structural openness and integration into global markets. Relative to annual data, the quarterly frequency increases the number of observations, improves the precision of nonlinear parameter estimates, and captures within year fluctuations that matter for policy timing, while mitigating aggregation bias.

Real GDP Growth ($Growth_{it}$): Year on year percentage change in real GDP, seasonally adjusted. Using year on year rather than quarter on quarter growth focuses on cyclical and trend components and avoids excess volatility from short term noise. Data are drawn from the Bank of Korea for South Korea and from Morocco's Haut Commissariat au Plan, cross checked with the OECD Quarterly National Accounts to ensure consistency.

Public Debt ($Debt_{it}$): General government gross debt as a percentage of GDP, encompassing central and local governments and social security funds. The main sources are the IMF Historical Public Debt Database and the World Economic Outlook, complemented by national fiscal reports where available to enhance comparability across countries.

Investment ($Investment_{it}$): Gross fixed capital formation as a share of GDP, used to control for capital accumulation, which is central in both neoclassical and endogenous growth frameworks.

Trade Openness ($TradeOpenness_{it}$): Sum of exports and imports of goods and services as a percentage of GDP, proxying the degree of integration into global markets. Trade openness can foster growth via technology diffusion, scale effects and competitive pressure, but also increases exposure to external shocks and global downturns.

Fiscal Balance ($FiscalBalance_{it}$): General government net lending/borrowing as a percentage of GDP, capturing the flow fiscal stance. Including both the stock of debt and the flow deficit helps disentangle the impact of accumulated liabilities from current fiscal policy decisions. Differences in debt composition and fiscal structures should be considered when interpreting cross-country comparisons.

Table 1 reports the main descriptive statistics for the sample period.

Table 1. Descriptive Statistics (1990Q1–2023Q4)

Variable	Country	Mean	Std. Dev.	Min	Max	Obs
GDP Growth (%)	South Korea	3.68	2.71	-4.20	8.50	136
	Morocco	2.33	2.60	-9.80	8.20	136
	Overall	3.01	2.73	-9.80	8.50	272

Public Debt (% GDP)	South Korea	43.3	15.5	21.2	75.2	136
	Morocco	63.7	7.18	52.2	85.2	136
	Overall	53.5	17.3	21.2	85.2	272
Investment (% GDP)	South Korea	35.4	1.85	28.5	38.2	136
	Morocco	33.4	2.01	26.5	39.8	136
	Overall	34.4	2.18	26.5	39.8	272
Trade Openness (% GDP)	South Korea	84.2	12.8	68.5	115.8	136
	Morocco	77.9	9.23	57.3	95.2	136
	Overall	81.1	11.8	57.3	115.8	272
Fiscal Balance (% GDP)	South Korea	+0.12	1.74	-5.25	+1.90	136
	Morocco	-3.85	2.32	-12.8	+0.30	136
	Overall	-1.87	2.98	-12.8	+1.90	272

Source: Bank of Korea; Haut-Commissariat au Plan (Morocco); OECD Quarterly National Accounts; IMF Historical Public Debt Database; IMF World Economic Outlook.

3.3 Estimation procedure and diagnostic tests

The PSTR model is estimated using a standard multi step procedure. First, linearity is tested against the PSTR alternative using an LM type test based on a first order Taylor expansion of the transition function, as proposed by González et al. (2005). Rejection of linearity justifies the use of a threshold type specification; failure to reject would favour a conventional linear panel model.

Second, the threshold parameter cc is selected by grid search rather than estimated directly in the nonlinear optimisation, which can be unstable. Candidate thresholds are evaluated over the 10th–90th percentiles of the observed debt distribution; for each candidate, the model is estimated and the residual sum of squares computed. The value of cc that minimises this criterion is retained as the threshold estimate.

Third, conditional on the selected threshold, the remaining parameters are estimated by nonlinear least squares after applying the within transformation to remove country fixed effects. This delivers consistent estimates under standard regularity conditions.

Finally, several robustness checks assess the stability of the results: (i) re estimating the model after excluding major crisis episodes such as the Asian Financial Crisis, the global financial crisis and the COVID 19 shock to ensure that the threshold is not driven by extreme observations; (ii) using lagged debt as the transition variable to mitigate potential reverse causality from growth to debt; and (iii) augmenting the specification with additional controls such as inflation, which may influence both debt dynamics and growth through real interest rates and fiscal dominance. While these exercises cannot fully resolve identification challenges inherent in macroeconomic panels, they help verify that the estimated threshold and regime dependent coefficients are not artefacts of outliers, particular sample periods or a specific functional form. A common threshold suggests shared macroeconomic constraints despite structural differences.

4 Results

4.1 Linearity tests and threshold identification

Before estimating the full PSTR model, linearity was tested against the smooth transition alternative. Both the LM and F type statistics reject the null of a linear relation-

ship at conventional significance levels, indicating that the marginal effect of public debt on growth is not constant and that a nonlinear specification is warranted.

The grid search procedure identifies a common public debt threshold at 56.5% of GDP, which minimises the residual sum of squares. This value lies between the lower ranges typically reported for emerging economies (around 30–50%) and the higher benchmarks found for advanced economies (around 80–90%), suggesting an intermediate "bridge" threshold shared by Morocco and South Korea despite their different development stages. Figure 1 illustrates the evolution of the debt ratios in both countries relative to this threshold: South Korea has remained mostly below 56.5%, except during major crises, whereas Morocco has operated above it for much of the past two decades, especially after 2008, implying different fiscal constraints over time.

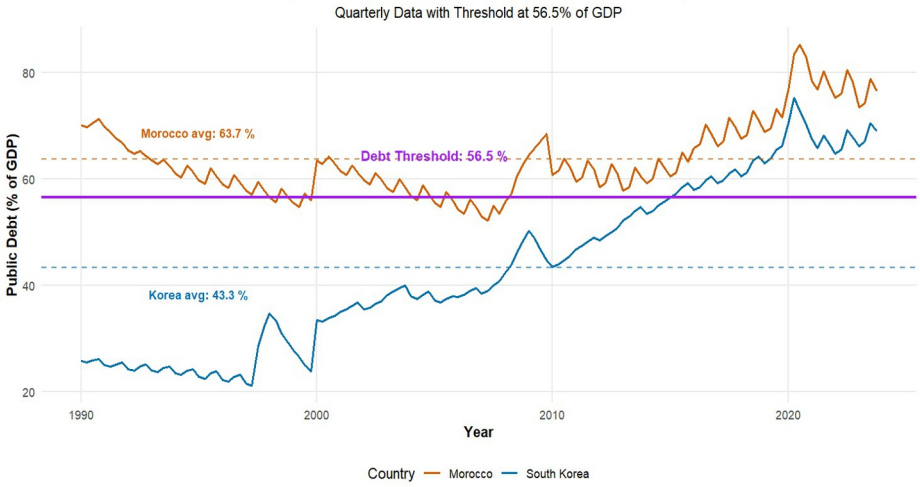

Figure 1. Evolution of public debt levels (1990–2023)

4.2 PSTR estimates and regime-dependent debt effects

Table 2 reports the estimated PSTR parameters.

The smoothness parameter $\gamma = 0.421$indicates a gradual transition between low and high debt regimes rather than an abrupt change. This implies that crossing the threshold does not create a discontinuous "cliff" but a progressive shift in the debt–growth relationship, giving policymakers some time to adjust policies as debt accumulates.

On the debt channel, the coefficient in the low debt regime is small and statistically insignificant ($\beta_0 \approx 0.02$), while the regime change parameter is positive and significant ($\beta_1 \approx 0.11$), yielding a high debt regime coefficient of about 0.13 that is strongly significant. Thus, in the PSTR specification, the marginal effect of public debt on growth is essentially zero at low debt levels but becomes significantly positive in the high debt regime, a result that contrasts with standard debt overhang predictions and points to the importance of how borrowed resources are used and of institutional quality. These results should be interpreted as conditional associations rather than strict causal effects.

For the control variables, investment has a robust positive effect on growth, with a coefficient around 0.40, consistent with growth theory. Trade openness is statistically insignificant in the low debt regime but becomes significantly negative in the high debt regime, while the fiscal balance is strongly growth enhancing in both regimes but with a smaller coefficient when debt is high. These regime dependent patterns suggest that debt levels critically condition the effectiveness of trade integration and fiscal policy.

Table 2.PSTR model parameter estimates

Parameter	Estimate	Std. Error	t-statistic	P-Value	95% CI
TRANSITION PARAMETERS:					
Threshold (c)	56.500	2.344	24.10	< 0.001***	[51.906, 61.094]
Smoothness (γ)	0.4212	0.1064	3.96	< 0.001***	[0.212, 0.630]
DEBT EFFECTS :					
Low-Debt Regime (β_0)	+0.0201	0.0556	0.36	0.719	[-0.089, +0.129]
Non-linear Change (β_1)	+0.1101	0.0350	3.15	0.004***	[+0.041, +0.179]
High-Debt Regime ($\beta_0+\beta_1$)	+0.1302	0.0207	6.29	< 0.001*	[+0.089, +0.171]
CONTROL VARIABLES (Linear):					
Investment	+0.3953	0.0573	6.90	< 0.001*	[+0.283, +0.508]
Trade Openness (Low)	+0.0045	0.0348	0.13	0.897	[-0.064, +0.073]
Trade Openness (High)*	-0.0804	0.0234	-3.44	0.001*	[-0.127, -0.034]
Fiscal Balance (Low)	+1.3850	0.1659	8.35	< 0.001*	[+1.059, +1.711]
Fiscal Balance (High)*	+0.9373	0.0525	17.85	< 0.001*	[+0.834, +1.041]
MODEL FIT:					
Observations	272	—	—	—	—
R^2	0.8421	—	—	—	—
Adjusted R^2	0.8365	—	—	—	—
Residual SD	0.9614	—	—	—	—
F-statistic	318.7	—	—	< 0.001***	—

Note: regime-specific effects for "high" debt are computed as β0+β1. Country fixed effects included but not reported.

4.3 Transmission channels: investment, trade and fiscal policy

The regime dependent coefficients for trade openness and fiscal balance highlight how high debt reshapes key transmission mechanisms. Investment retains a stable and positive contribution to growth across regimes, indicating that capital accumulation remains a robust driver irrespective of the debt level. By contrast, trade openness is essentially neutral for growth when debt is low but becomes significantly contractionary once debt exceeds the threshold, suggesting that, in high debt environments, greater exposure to external shocks and limited fiscal space to respond may dominate the usual gains from integration.

Fiscal policy effectiveness also deteriorates with higher debt. The fiscal balance coefficient falls from about 1.39 in the low debt regime to roughly 0.94 in the high debt regime, implying an erosion of the fiscal multiplier of around 32% even though it remains above one. In practice, this means that when public debt is already elevated, additional deficit financed spending still supports growth but with substantially diminished effectiveness, reducing governments' capacity to conduct countercyclical policy during adverse shocks. Figures 2 and 3, which contrast linear and PSTR estimates and visualise regime allocations, illustrate how a simple linear model would mask these regime specific patterns.

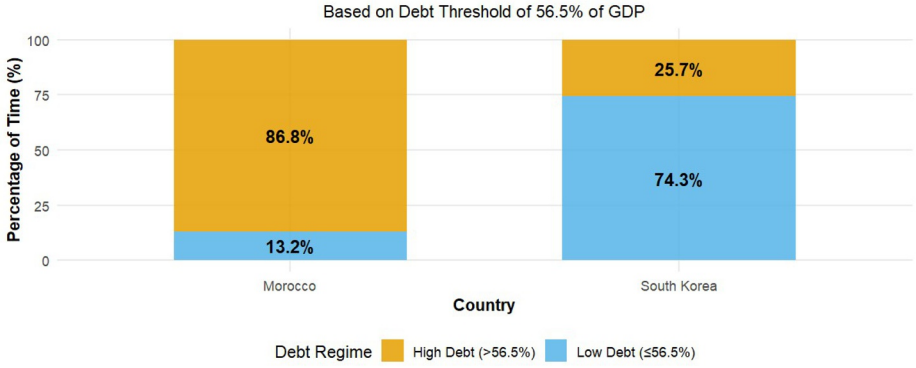

Figure 2. Scatter of public debt and GDP growth with regimes

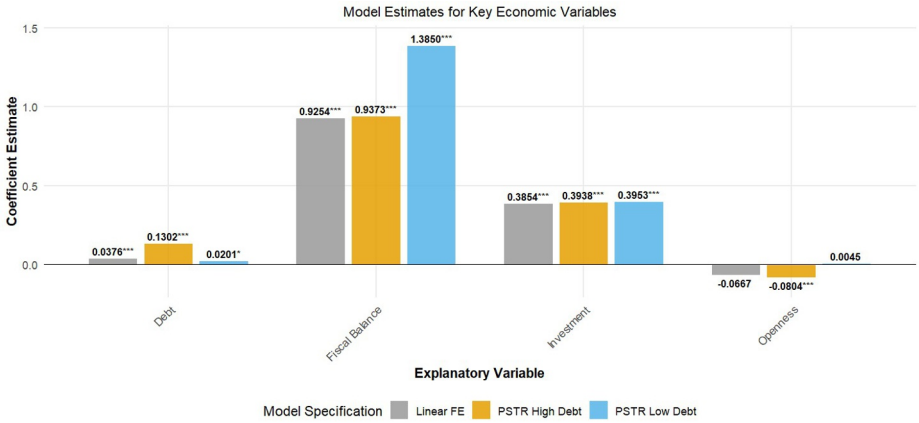

Figure 3. Linear vs PSTR coefficients by regime

4.4 Non-linear marginal effects and transition dynamics

Using the estimated parameters, the marginal effect of public debt on growth is traced over the observed debt range. The resulting curve is non monotonic: the marginal effect is positive at low debt levels, declines as debt rises, turns slightly negative over an intermediate range, and then stabilises at a positive value in the high debt regime consistent with the estimated high regime coefficient. A linear specification would compress this rich pattern into a single slope and fail to capture the variation in the debt–growth semi elasticity across the distribution.

The estimated logistic transition function, centred at 56.5% of GDP, confirms that regime changes occur smoothly. At debt levels around 40% of GDP, the economy is still predominantly in the low debt regime but already transitioning, whereas by 70% it is firmly in the high debt regime. Figures 4 and 5 illustrate the shape of the marginal effect curve and the S shaped transition function, providing a transparent map of how incremental borrowing affects growth at different debt ratios.

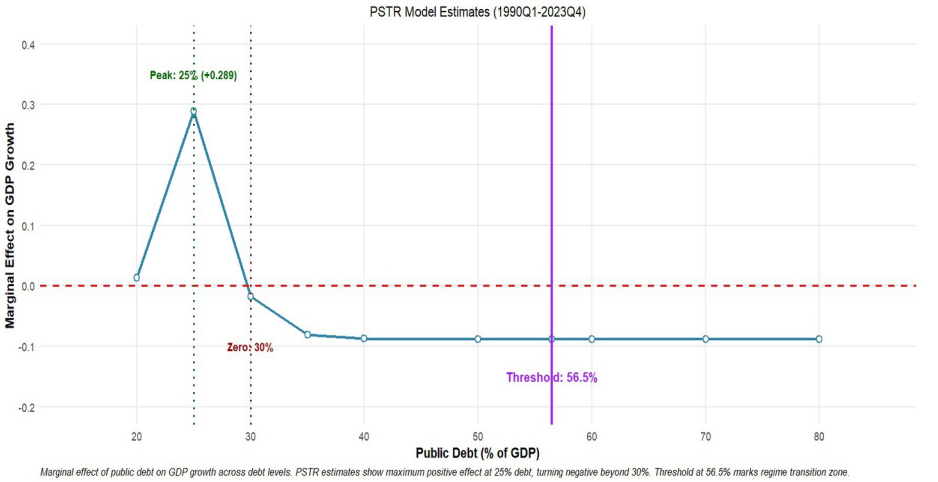

Figure 4. Marginal effect of public debt on GDP growth

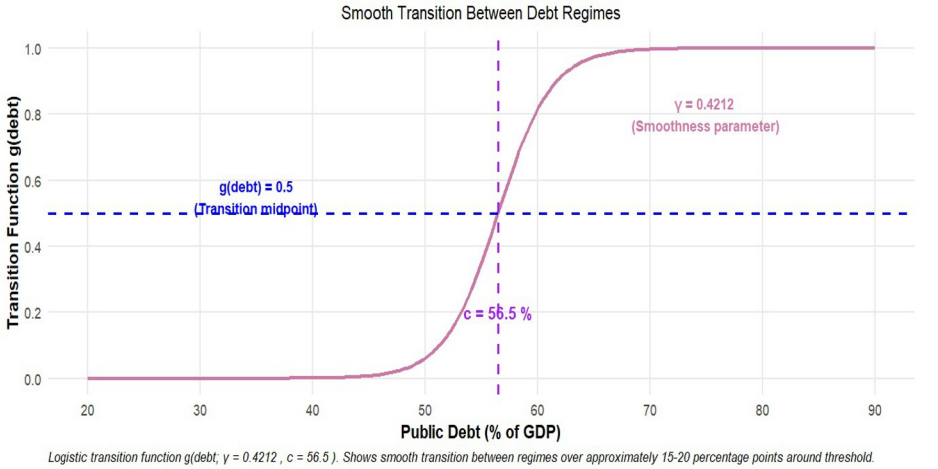

Figure 5. Logistic transition function centred at 56.5%

4.5 Robustness checks and diagnostics

A series of robustness exercises confirm that the main findings are not driven by a particular sample period or specification. Re estimating the model after excluding major crisis episodes (Asian Financial Crisis, global financial crisis, COVID 19) yields very similar results, with the estimated threshold shifting only marginally from 56.5% to about 56.8–56.9%, well within the confidence interval. Using lagged debt as the transition variable to mitigate reverse causality concerns also leaves the core parameters largely unchanged.

Standard diagnostic tests indicate no problematic serial correlation or heteroscedasticity in the residuals, and the overall fit of the model is strong, with an R^2 above 0.84.

Taken together, these exercises reinforce the robustness of the empirical picture: a common debt threshold around 56.5% of GDP for Morocco and South Korea, a regime dependent and, in high debt states, positive direct effect of debt on growth, and significant changes in the effectiveness of trade openness and fiscal policy across debt regimes.

5 Discussion

5.1 Interpreting the debt productivity puzzle

The results reveal a more nuanced debt–growth relationship than standard overhang narratives suggest. Conventional theory postulates that public debt supports growth at low levels but becomes a drag as it accumulates; in contrast, this study finds that the marginal effect of debt on growth is essentially zero below the threshold and significantly positive above it. This counterintuitive finding can be reconciled by considering how borrowed resources are used. Both South Korea and Morocco have channelled a substantial share of their public borrowing into infrastructure, education and strategic investment, such that stronger institutions and more effective project selection allow debt to remain growth enhancing even at elevated levels. Productive debt utilization may explain the positive effect, although further research is needed to confirm this mechanism. This is consistent with the view that the impact of debt depends on institutional quality and investment efficiency rather than on the debt ratio alone.

5.2 The development bridge threshold

The common threshold around 56.5% of GDP sits between the lower ranges typically reported for emerging economies and the higher benchmarks for advanced economies, suggesting an intermediate "development bridge" level. Morocco, an emerging market that has undertaken institutional and fiscal reforms, appears able to sustain a higher threshold than many low-income peers, whereas South Korea, now an advanced Asian economy but with a vivid memory of the Asian Financial Crisis, may face a lower effective tolerance than very high debt advanced economies such as Japan. This supports the notion that "debt intolerance" is path dependent: thresholds are shaped jointly by institutions, historical crises and market perceptions, not simply by income per capita.

5.3 Hidden costs: fiscal and trade vulnerability

The main costs of high debt do not arise from the direct coefficient on debt, but from how elevated debt erodes the effectiveness of other policy levers. The fiscal multiplier falls by roughly one third when moving from the low debt to the high debt regime, implying that discretionary fiscal policy remains expansionary but delivers less growth per unit of deficit when debt is already high. For Morocco, which has spent prolonged periods above the threshold, this means that countercyclical space is structurally constrained: shocks such as droughts, commodity price swings or global downturns hit harder because each additional dirham of spending yields smaller growth gains. South Korea, by contrast, has typically operated below the threshold, entering the high debt regime mainly after large crisis responses, which has preserved more room for effective fiscal interventions during much of the sample.

Trade openness also exhibits regime dependent effects. At low debt levels, it is broadly neutral for growth, but in the high debt regime it becomes significantly negative, turning integration into a transmission channel for external volatility rather than a

source of gains. One plausible explanation is that high debt constrains the complementary public investment and social buffers needed to reap the benefits of openness, especially in economies exposed to sudden stops or terms of trade shocks. For emerging and newly advanced Asian economies, this suggests that deeper trade integration should be sequenced with, and conditional on, maintaining fiscal sustainability, rather than pursued independently of debt dynamics.

5.4 The policy value of gradual transitions

The estimated smoothness parameter indicates that regime changes occur gradually over a band of roughly 15–20 percentage points of GDP around the 56.5% threshold, rather than at a sharp cutoff. This has important policy implications. Instead of facing a binary classification of "safe" versus "unsafe" debt levels, governments transit through a "caution zone" in which the effectiveness of fiscal policy and the impact of openness begin to deteriorate, but the high debt regime is not yet fully in place. For Morocco, currently close to or just above the estimated threshold, this implies that proactive consolidation, revenue mobilisation and expenditure reprioritisation can still prevent a full loss of fiscal space. For South Korea and other Asian economies with rising debt trajectories, the same smooth transition offers an early warning framework: policy adjustments can be implemented before the full costs of high debt materialise.

5.5 Implications for the debt-growth literature

These findings contribute to the broader debate on public debt and growth in several ways. First, they reinforce the view that universal numerical thresholds are neither empirically robust nor conceptually appropriate: the 56.5% level uncovered here is informative for Morocco and South Korea, but its relevance elsewhere depends on institutional and structural conditions. Second, they highlight that the most important consequences of high debt may operate through indirect channelsreduced fiscal space and heightened external vulnerabilityrather than through a simple negative marginal effect of debt on growth. Third, they illustrate the added value of smooth transition frameworks: by capturing gradual regime shifts, the PSTR approach delivers more realistic policy messages than either linear models, which average over regimes, or discrete thresholds, which imply implausible knife edge dynamics. For emerging and advanced Asian economies facing rapid debt accumulation, this suggests that future research should further explore how institutional improvements and policy design can shift not only the level of the threshold but also the width and properties of the transition zone.

6 Conclusion and Policy implications

This paper set out to examine whether public debt affects economic growth differently at low and high debt levels, and whether these non-linearities differ between an emerging economy and a recently advanced Asian economy. Using quarterly data from 1990 to 2023 and a Panel Smooth Transition Regression model, the analysis identifies a common public debt threshold at about 56.5% of GDP for Morocco and South Korea, around which the debt–growth relationship changes. This intermediate level lies between the lower thresholds often reported for emerging economies and the higher benchmarks for advanced economies, suggesting that the two countries occupy a "development bridge" position in the global debt landscape.

The most striking result is the "debt productivity puzzle": below the threshold, the marginal effect of debt on growth is statistically negligible, while above it the effect becomes significantly positive. This contrasts with standard debt overhang theory, which predicts that high debt dampens growth. The evidence indicates that both countries have used a large share of borrowed resources to finance productive investment in infrastructure, human capital and strategic sectors, and that sufficiently strong institutions can sustain positive growth effects from debt even at elevated levels. However, the costs of high debt appear through indirect channels: fiscal multipliers fall by roughly one third in the high debt regime and trade openness turns from neutral to significantly negative for growth, implying reduced fiscal space and greater vulnerability to external shocks.

The estimated smooth transition between regimes, rather than an abrupt break, has important policy implications. As debt moves from around 50% to 65% of GDP, the economy passes gradually from a low debt to a high debt regime, creating a "caution zone" in which fiscal effectiveness and the benefits of openness begin to deteriorate but have not yet collapsed. For South Korea, which has historically operated mainly below the threshold and entered the high debt zone mainly after large crisis responses, the priority is to preserve fiscal space while using it strategically to address long-term challenges such as ageing, technological competition and geopolitical risks. For Morocco, which has spent much of the last two decades above the threshold, the priority is credible medium-term consolidation that gradually reduces the debt ratio, combined with stronger revenue mobilisation and a sharper focus on high quality public investment that supports export capacity and resilience.

These findings carry broader lessons for emerging and advanced Asian economies facing rising public debt. They reinforce that there is no universal safe debt ratio; thresholds are shaped by institutions, policy credibility, financial development and crisis histories. At the same time, countries with comparable structural characteristics may share similar threshold dynamics, even at different income levels. Debt can remain growth enhancing at relatively high levels when institutions ensure that borrowing finances productive projects, but the erosion of fiscal space and the weakening of trade related gains impose real constraints on macroeconomic management. Effective debt policy therefore requires monitoring not only headline debt ratios but also the evolution of fiscal multipliers, external vulnerability and investment efficiency, with the goal of maintaining public debt as a development tool rather than allowing it to become a structural constraint. These findings highlight the importance of context-specific debt management strategies rather than reliance on universal debt thresholds.

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