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Explaining Cross-Country Heterogeneity in Debt Overhang Thresholds

Rina Bhattacharya, Alexei G. Goumilevski, Carlos Guevara, Justin Lesniak, and Flora Lutz

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ABSTRACT: This paper estimates debt overhang thresholds separately for 105 countries using a Kalman Filter approach applied to a standard growth model. The results reveal pronounced heterogeneity in the estimated thresholds, both within and across country groups but limited time-variation. In a second step, we explore the structural factors underlying this heterogeneity. The empirical results underscore that a strong payment track record, high quality institutions and governance, public debt composition (currency, maturity, and creditor base), and financial market size and development are associated with higher pubic debt overhang thresholds.

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WORKING PAPERS

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I. Introduction

What is the debt-carrying capacity of the public sector, and what are the determining factors? This question has been part of an ongoing debate in both academia and among policy makers over several decades. Amidst the recent surge in debt levels of public sectors in both Advanced Economies (AEs) and Emerging Markets and Developing Economies (EMDEs) since the onset of the pandemic, concerns regarding debt sustainability and the relationship between public debt and economic growth have lately re-emerged, in the context of generally tightening conditions in world financial markets.

There have been two broad approaches to estimating public debt limits or debt-carrying capacity of economies. The first approach is based on considerations of fiscal sustainability and loss of market access, and includes for example estimation of Long-term Debt Benchmarks, Natural Debt Limits, or application of the Value-at-Risk approach (Nicholls and Peter, 2014; Ghosh et al, 2013; Jiang et al, forthcoming). The second approach is to estimate a relationship between public debt and per capita GDP growth, and subsequently define the debt overhang threshold as the level of the public debt-to-GDP ratio beyond which additional debt accumulation is associated with a deceleration in economic growth.

In this study we do not address issues of debt sustainability but instead focus on estimating public debt overhang thresholds' – defined as the level of public debt at which the marginal impact of additional debt accumulation on per capita GDP growth switches from positive to negative. In the first stage of our empirical analysis we estimate debt overhang thresholds separately for 105 countries using panel data and a Kalman Filter methodology to get time-varying estimates of the debt overhang threshold for each country. In the second stage of the analysis we examine the role of five sets of factors that could help explain cross-country heterogeneity in the relationship between public indebtedness and per capita economic growth: (i) a country's track record in meeting its sovereign debt service obligations; (ii) the quality of a country's institutions and governance; (iii) the composition and structure of the stock of public debt (in terms of currency, maturity, and creditor base); (iv) the size of the domestic financial market; and (v) indicators of depth, access, and efficiency of a country's domestic financial sector.

To estimate debt thresholds, we apply a standard Kalman Filter methodology to derive time-varying estimates of a debt overhang threshold separately for 105 countries, taking account of the findings of many recent studies (e.g. Pescatori, Sandri, and Simon, 2014) that found no evidence of a universal public debt threshold beyond which medium-term growth prospects deteriorate. More specifically, we estimate standard growth regressions that relate per capita real GDP growth to public indebtedness and macroeconomic variables that are commonly used in the existing literature. The key novelty of our empirical analysis is to treat the public debt threshold as an unobservable, time-varying state variable, estimated via a Kalman Filter and allowing us to identify country-specific thresholds for 105 countries. The marginal impact of public debt on per capita real GDP growth varies according to whether public debt is below or above this threshold. More specifically, the public debt variable is interacted with an indicator variable based on whether it exceeds the threshold. This allows identification of nonlinearities in the public debt-growth relationship.

In line with the recent literature our empirical estimates reveal striking cross-country heterogeneity in the estimated debt overhang thresholds, which range from around 20% of GDP to almost 210% of GDP, with a mean of 67% and a median of 64%. There is also considerable variation in the estimated debt overhang threshold across country groups (fuel exporters; high income countries; upper middle-income countries; lower middle-income countries; and low-income countries), with the mean threshold ranging from over 52% of GDP

for fuel exporters to around 85% of GDP for high income countries. Interestingly however, the estimated thresholds display relatively limited time-variation for individual countries and country groups.

Regarding the drivers of these thresholds, our empirical results suggest that payment track record can be an important determinant of debt overhang thresholds, though its influence varies by country group. Good governance (stronger law and order and improved bureaucratic quality) is consistently associated with higher thresholds, suggesting that institutional strength enhances a country's capacity to sustain public debt without adversely affecting economic growth. Conversely, a greater share of non-resident public debt, and of public debt held by official creditors, tend to lower the threshold, indicating heightened vulnerability to external financing conditions. We also find that a higher share of short-term external debt in total external debt is linked to a reduced public debt overhang threshold for some country groups, reflecting the potential importance of increased rollover risk.

Importantly, our results also provide strong evidence that the size of the domestic financial sector is associated positively with the debt overhang threshold, and this applies both to banks and deposit-taking financial institutions and to nonbank financial corporations. However, capital market size – measured by stock market capitalization and outstanding stock of (public and private) debt securities issuances in percent of GDP – does not seem to have an impact on the estimated thresholds, likely reflecting the small sample size. Finally, we uncover robust evidence that financial development—encompassing both financial markets and financial institutions—raises the debt overhang threshold, albeit with notable variation across country groups.

This paper contributes to existing literature in several ways. First, to the best of our knowledge, there are only three other papers that estimate public debt-growth thresholds separately for individual countries or groups of countries. Gómez-Puig and Sosvilla-Rivero (2017) estimate 'debt overhang thresholds' separately for 11 European countries over the period 1961–2015. Ahlborn and Schweikert (2018) as well as Gómez-Puig and Sosvilla-Rivero (2024) do the same for five groups of countries over the period 1995–2016, using an empirical methodology that endogenously classifies countries into five separate groups. By contrast we use a methodology, a Kalman Filter applied to a standard growth model, that has not been applied in this context before to derive time-varying estimates of a debt overhang threshold separately for a large number of countries at varying levels of income and development. We then go on to study potential drivers of the considerable cross-country heterogeneity in these estimates but using a much larger set of possible explanatory factors than has, to the best of our knowledge, been examined in the existing literature. Hence, we think that our study, in addition to providing new estimates of 'debt overhang thresholds' for a large number of countries using an empirical methodology that has not been used so far to address this issue, also adds to our existing understanding of the drivers of cross-country heterogeneity in these thresholds.

The paper proceeds as follows. Section II provides a brief review of literature. This is followed in Section III with a brief discussion of the data used in empirical estimation, and in Section IV with more details of the empirical methodology applied in this study. Section V presents the empirical results, while Section VI concludes. Annex 1 provides more details of the variables used in the empirical estimations and the data sources, and Annex 2 presents the baseline regression results.

II. Literature Review

According to the conventional view in the theoretical literature, public debt accumulation, in essence fiscal deficit financing, can stimulate aggregate demand and output in the short run (in the absence of non-Keynesian effects). In the long-run, however, public debt can crowd-out capital and reduce output by (i) lowering national savings, thereby pushing up interest rates and reducing investment (Barro, 1990; Saint-Paul, 1992); (ii) creating a debt overhang problem – a situation where a large share of output accrues to foreign lenders, thereby creating disincentives to invest or to undertake growth-promoting structural reforms (Krugman, 1988); (iii) expectations of future distortionary taxation (Barro, 1979) or of significant cuts in public spending, with adverse effects on long-term economic growth; (iv) expectations of emerging inflationary pressures due to fiscal dominance (Sargent and Wallace, 1981); (v) higher volatility of economic growth due to constrained scope for counter-cyclical fiscal policy (e.g., Aghion and Kharroubi, 2013); and (vi) higher uncertainty about future policy and prospects. In the more extreme case of a debt crisis, effects can be magnified by triggering banking or currency crises. One counter argument to the negative relationship between economic growth and public debt in the long run, however, is that by mitigating protracted recessions, counter-cyclical fiscal stimuli could reduce permanent output costs. Public debt accumulation can also stimulate long-term growth by helping to address urgent human development needs and physical infrastructure gaps. DeLong and Summers (2012) further argue that, in a low-interest rate environment, expansionary fiscal policy is likely to be self-financing.

The empirical literature on the growth-debt nexus dates back to the contribution of Reinhart and Rogoff (2010), with their findings of a negative relationship between high levels of debt and economic growth in advanced economies.[1] While the results have been challenged by Herdon, Ash, and Pollin (2013), who show that the threshold effect seems to vanish after correcting for a coding error and using a different weighting of the data, the debate still remains far from settled. Since then, a number of studies have analyzed the robustness of this finding based on econometric models controlling for possible covariates of public debt and growth (e.g. Cecchetti, Mohanty, and Zampolli, 2012; Checherita-Westphal and Rother, 2012; Woo and Kumar, 2015), accounting for endogeneity (e.g. Checherita-Wetphal and Rother, 2012; Panizza and Presbitero, 2014; Pescatori, Sandri, and Simon, 2014; Woo and Kumar, 2015) and extending the sample to longer time-periods as well as to emerging and developing economies.[2] Several studies also tested potential non-linearities in the relationship between public debt and growth by including simple quadratic terms in the growth regressions (Checherita-Westphal and Rother, 2012), fitting spline regressions allowing for one or more knots (Egert, 2012; Woo and Kumar, 2015), and panel threshold regressions which allow for estimating exogenous thresholds rather than fixing them at arbitrary values (Cecchetti, Mohanty, and Zampolli, 2012; Baum, Checherita-Westphal, Kourtellos, and Tan, 2012). The findings of these studies are generally mixed, with some finding evidence for an inverse U-shaped relationship (Kaminsky and Pereira, 1996; Elbadawi, Ndulu, and Ndung'u, 1997; Pattillo, Poirson, and Ricci, 2011), some pointing to more complex relationships (Cordella, Ricci, and Ruiz-Arranz, 2010), and others finding no evidence for a universally applicable threshold effect in the relationship between public debt and economic growth (Pescatori, Sandri, and Simon, 2014; Chudik, Mohaddes, Pesaran, and Raissi, 2017).

[1] Panizza and Presbitero (2014) provide an in-depth literature review.

[2] Important contributions include Augustine and Rafi (2023), who assess the dynamics between public debt and economic growth by estimating the threshold level of debt for thirty-nine emerging and developing economies, Ahlborn and Schweickert (2018), and Gomez-Puig and Sosvilla-Rivero (2024), who assess cross-country heterogeneities by endogenously grouping countries into sub-groups.

Another strand of the literature has focused on the determinants of cross-country heterogeneities in the debt-growth nexus, acknowledging that the effect of public debt on growth may also depend on country-specific characteristics. Important factors that have been identified in the literature include the quality of a country's institutions (e.g., Kourtellos, Stengos, and Tan, 2012; Gomez-Puig and Sosvilla-Rivero, 2024), the maturity and currency composition of public debt (e.g., Gomez-Puig and Sosvilla-Rivero, 2017 and 2024; Woo and Kumar, 2015), fiscal uncertainty (e.g., Ahlborn and Schweickert, 2018) and the debt trajectory (e.g, Pescatori, Sandri, and Simon, 2014; Chudik, Mohaddes, Pesaran, and Raissi, 2017). Eberhardt and Presbitero (2015) further argue that heterogeneities in production technologies, in the composition of debt as well as in macroeconomic and institutional frameworks, could be of importance. In this study, we expand upon the existing literature by estimating heterogenous debt thresholds and exploring the drivers of this heterogeneity with a larger and broader set of explanatory variables than have been examined to date. Before going to the estimation methodology and empirical results, the next section provides a brief discussion of data issues.

III. Data Issues

For the analysis in this paper, we compile a panel dataset covering 105 countries over the period 1980–2022, including information on public debt and various control variables. To do this, we draw on a wide range of sources (see Table in Annex 1 for details). A key challenge lies in obtaining public debt data disaggregated by holder, maturity, and currency, which are available across multiple sources but often differ in definitions and measurement approaches. While we verified that trends in total public debt levels were broadly consistent across sources, minor definitional discrepancies remain. The remainder of this section outlines the variables used in our analysis and their respective data sources.

For the first-stage regressions we primarily rely on data from the IMF's World Economic Outlook (WEO) database, the World Bank's World Development Indicators, and Penn World Tables. To capture information on capital stock across countries we use the Penn World Tables, which provide data up to 2018; we extend this series through 2022 using the perpetual inventory method. Our main source for constructing the public debt-to-GDP series is the IMF's Sovereign Debt Investor Database, compiled by Arslanalp and Tsuda, which offers detailed data on sovereign debt by holder beginning in 1989 for a broad set of countries. To build a longer time series reaching back to 1980, we supplement this with data from the IMF's Historical Public Debt Database. Variables on debt composition are drawn from multiple sources. As noted above, the Arslanalp and Tsuda dataset contains information on sovereign debt disaggregated by holders and their foreign/domestic status. For foreign currency debt we rely on data from the IMF's World Economic Outlook (WEO) database, while data on the share of short-term external debt in total external debt is sourced from the World Bank's World Development Indicators.

To construct our payment track record variable, we use data on debt in arrears or default from the Bank of Canada-Bank of England debt database, which provides data on arrears by creditor type. We assume that missing data in this dataset reflects zero arrears (no default). Using total arrears, we then calculate the annual share of debt in arrears and define our historical track record variable as a 20-year rolling average of this share.

Governance indicators are obtained from the International Country Risk Guide ICRG database, a widely used source of political and economic indicators which is based on surveys of experts. Our primary variable, the political risk index, measures overall political risk in a country and includes important sub-components such as Law and Order, Corruption, Government Stability, and Bureaucratic Quality, some of which we use in our

empirical analysis. In one specification we incorporate the composite risk rating index, which combines political, financial, and economic risk.

Data on financial sector size is drawn from the IMF's Monetary and Financial Statistics and the World Bank's Global Financial Development database. The banking sector is measured by total assets of ODCs (banks and other deposit-taking financial institutions), while nonbank financial corporations are measured by the assets of OFCs (non-deposit taking non-bank financial institutions), also taken from the IMF's Monetary and Financial Statistics. We define capital market size as the sum of stock market capitalization plus debt securities issuances by the public and private sectors, based on World Bank data.

For financial sector development we use the IMF's Financial Development Index dataset, drawing on the overall index (FD) as well as the first level sub-indices: Financial Institutions (FI) and Financial Markets (FM). These sub-indices separately capture the development of banking systems and the non-bank financial sector, including capital markets.

Finally, in order to categorize our sample of countries into groups, we use the World Bank's income classifications combined with a list of fuel exporters from the IMF's WEO database. We restrict our sample to those countries for which at least forty consecutive years of data are available to carry out the first stage of the empirical analysis.

IV. Empirical Methodology

The public debt overhang threshold for countries is unobservable and requires specialized techniques for estimation. To address this, we adopted a state-space modeling approach where the debt overhang threshold represents the unobserved state variable, which we estimate using a Kalman Filter for the first stage of our empirical analysis. Details of this approach are provided below.

Measurement Equation:

$$g_{i,t} = \alpha_{i,t} + \beta_0 y_{i,t-1} + \beta_1 \Delta POPWA_{i,t-1} + \beta_2 \Delta HCI_{i,t-1} + \beta_3 \Delta KSTPC_{i,t-1} + \beta_4 \Delta OPEN_{i,t-1}$$

$$+\beta_5 \Delta TOT_{i,t} + \gamma_1 \Delta d_{i,t-1} + \gamma_2 * \max\left(d_{i,t-1} - d^*_{i,t-1}, 0\right) + \gamma_3 * \min\left(d_{i,t-1} - d^*_{i,t-1}, 0\right) + DUM_{COVID} + \xi_t \quad (1)$$

Here g is the growth of per capita GDP, y is the log of per capita GDP, POPWA is the log of population of working age, KSTPC is the log of Capital stock per capita, HCI is the log of Human Capital Index, OPEN is the openness (exports plus imports in percent of GDP), TOT is the log of terms of trade, d is the public debt to GDP ratio, d^* is the debt overhang threshold in percent of GDP, and DUM_{COVID} is a dummy variable that takes the value of one for the COVID years 2020, 2021, and 2022 and zero otherwise. Equation (1) represents the measurement equation for the model.

The unobserved debt threshold is one of the factors in equation (1) explaining per capita GDP growth. In economics, the Kalman filter (KF) is commonly applied to predict unobserved threshold values, such as regime changes, structural breaks, and nonlinearities in economic behavior. The KF treats these threshold variables as latent states within a state-space framework. It optimizes the estimation of latent variables by minimizing the mean squared error. By balancing the uncertainties in both the measured per capita GDP growth and the debt overhang threshold, it produces the best estimate—one that is a minimum variance unbiased estimator.

Pancela et al. (2021) provides a comprehensive summary of latent factor extraction using the KF, which is highly relevant to estimating unobserved thresholds in economic models. Holston et al. apply the KF to estimate the natural rate of interest, or r-star, defined as the real short-term interest rate expected to prevail when the economy is operating at full capacity and inflation is stable. Sirikanchanarak et al. (2016) explore the application of the KF to estimate models with thresholds that vary over time. Additionally, Harvey and Simons employ the KF to estimate hidden states and regime-switching mechanisms based on threshold crossings.

State Equations:

Two alternative state equations were considered for the evolution of the debt overhang threshold *d**:
Random walk model:

$$d^*_{i,t} = d^*_{i,t-1} + \eta_t$$

$$\eta_t \sim N(0, \gamma_0) \quad \text{(2a)}$$

where γ_0 is derived from the variance of the detrended public debt-to-GDP ratio for each country or country group (typically 40–70% of this variance).

Mean-reverting model:

$$d^*_{i,t} = \rho\, d^*_{i,t-1} + (1-\rho)\, \bar{d}^*_i + \eta_t$$

$$\eta_t \sim N(0, \gamma_0) \quad \text{(2b)}$$

Here the parameter ρ is selected from the range [0.3, 1] over intervals of 0.1.

Since $\rho < 1$, the computed debt overhang thresholds converge faster than in the case of $\rho = 1$, i.e., it displays less volatility than the random walk model. The Kalman filter estimates the unobserved debt threshold by minimizing the error between the measured and estimated values of per capita GDP growth rate, while accounting for uncertainties in the measurements of both GDP growth and debt threshold values.

Initial values of the debt overhang threshold $d_{i,0}^*$ are taken from a grid search covering a dynamic range from 20 percent of GDP to 1.5 times the maximum value of the debt-to-GDP ratio (in percent) for each country over the period 1980 to 2022, with the grid encompassing 100 starting points for estimation of the debt overhang threshold. For several countries, however, lower and upper debt threshold limits were imposed based on the authors' judgment to provide a wider range for the grid search, particularly when the initial threshold estimates seemed to be on the low / high side, given the structure of the economy.

$\bar{d}_i^*$ is the average (steady state) of the debt overhang threshold and is computed in two steps. In the first step $\bar{d}_i^*$ is taken to be the initial value of the public debt to GDP ratio (in percent) for each country. In the second step $\bar{d}_i^*$ is computed as the average of the debt overhang thresholds estimated using the first step over the period 1980–2022. The results reported in this paper are the estimates of the sample from the second stage estimations for the values from the grid search that give the highest values of the log likelihood function. This log-likelihood was computed by running the Kalman filter for the forecasts of the debt threshold, where their initial values were set to the grid points. This produced a set of 100 values, from which we selected the debt threshold forecast with the highest log-likelihood value. The coefficients α, β, and γ of measurement equation (1) were estimated by running regressions for each country.

The limitations of the current approach may include missing endogenous variables in the measurement equation (1), such as a country's creditworthiness, borrowing costs, and interest payments on its national debt. The latter can consume a significant portion of the country's budget and reduce investments that drive GDP growth. Another limitation is the potential for reverse causality, where low growth leads to higher debt and a higher debt threshold as countries are tempted to stimulate their economies by adopting counter-cyclical fiscal policy. To address these issues, standard methods such as instrumental variables and second-stage panel regressions can be applied.

After discussing the results of the KF estimation we go on to analyze what may explain cross-country heterogeneity in debt overhang thresholds across different groups of countries by applying Generalized Least Squares (GLS) to panel data and regressing the estimated debt overhang thresholds against five sets of factors that could potentially explain cross-country heterogeneity in the relationship between public indebtedness and per capita GDP growth: (i) a country's track record in meeting its sovereign debt service obligations, as emphasized in Reinhart, Rogoff, and Savastano (2003); (ii) the quality of a country's institutions and governance; (iii) the composition and structure of the stock of public debt (in terms of currency, maturity, and creditor base); (iv) the size of the domestic financial market; and (v) indicators of depth, access, and efficiency of the country's domestic financial sector.[3, 4]

V. Empirical Results

Baseline Stage 1 Results

The baseline results that we present start with estimating Equation (1), the measurement equation, with the state equation as defined in Equation (2a), and with the variance of the error term of the state equation taken to be 0.7 of the variance of the detrended public debt-to-GDP ratio for each individual country. Table 1 below, and Figures 1–4, present the results for five separate groups of countries – (i) fuel exporters (FEs), (ii) high-income countries (HICs), (iii) upper middle-income countries (UMICs), (iv) low middle-income countries (LMICs), and

[3] According to the methodologies of compiling these indicators, depth measures the size and liquidity of the financial markets and institutions, access evaluates how easy it is for individuals and businesses to access financial resources and services, and efficiency assesses the effectiveness and low-cost provision of financial services by financial markets and institutions.

[4] Our baseline GLS estimates correct for heteroskedasticity across countries and for serial correlation within countries, but not for cross-sectional dependence across countries.

(v) low-income countries (LICs). The group debt thresholds were obtained by averaging the estimated debt overhang thresholds for the individual countries in the group.

Table 1 below presents the number of countries in each country group and the whole sample, as well as the mean and median values over the entire sample period of the estimated debt overhang thresholds. It also provides information on the minimum and maximum values of the estimated debt overhang thresholds for the whole sample and for each group, together with the standard errors of these estimates. Figure 1 below plots over time the group averages of the estimated public 'debt overhang thresholds', and of the actual levels of public debt, over the sample period (1980–2022).

Table 1. Baseline Regression Debt Overhang Thresholds

	No. of countries	Mean	Median	Min	Max	Std
Fuel Exporters	13	52.5	52.2	21.5	102.2	2.3
High Income Countries	24	85.2	85.0	33.3	209.2	4.7
Upper Middle Income	10	79.5	79.6	35.3	121.4	2.8
Lower Middle Income	26	64.0	63.8	20.0	128.2	4.9
Low Income Countries	32	55.5	55.5	20.0	142.8	5.4
All	105	67.3	63.8	20.0	209.2	4.5

Source: IMF Staff calculations

Figure 1. Public Debt Overhang Threshold and Average Public Debt for Five Country Groups

Figure 1.A. Estimated Threshold of Public Debt Overhang (group averages)

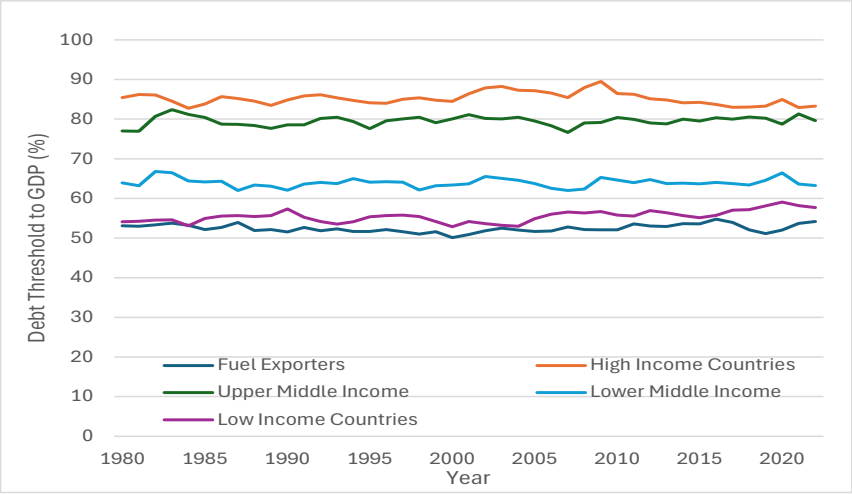


Figure 1. Public Debt Overhang Threshold and Average Public Debt for Five Country Groups (Concluded)

Figure 1.B. Actual Public Debt (group averages)

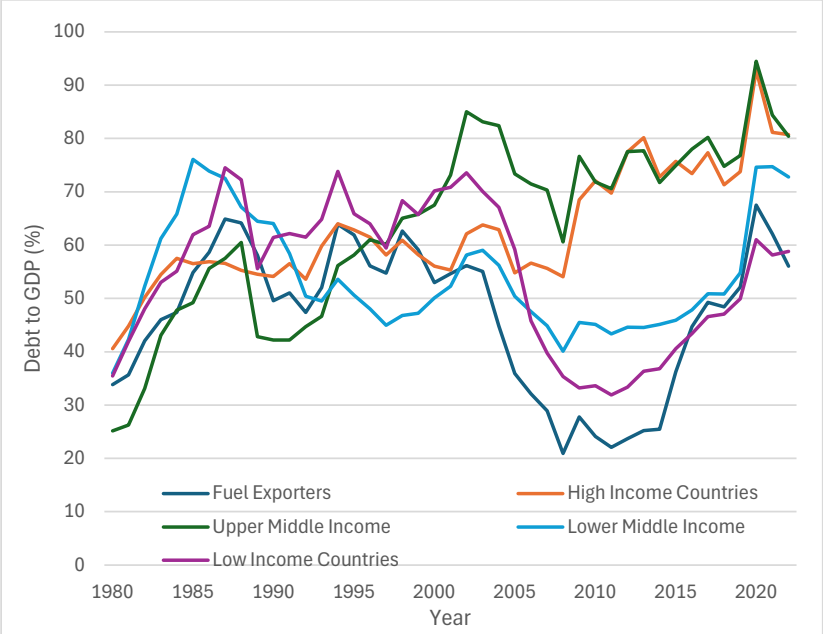


Figure 2 provides more detail for each of the five groups, presenting the 25th, 50th, and 75th percentiles, along with the mean levels of debt thresholds for these groups. The time-variation of the debt overhang thresholds is relatively limited within most groups, likely reflecting slow movement of the underlying structural factors driving these thresholds (e.g., strengthening of institutional quality or deepening of financial markets). The estimated thresholds also illustrate distinct responses to crises such as the Global Financial Crisis (GFC) and COVID-19. At the same time, there is considerable variation of the estimated debt overhang thresholds across country groups, with the mean threshold ranging from over 52% of GDP for fuel exporters to around 85% of GDP for high income countries. The country-level estimates vary from a low of 20% of GDP to a high of almost 210% of GDP over the sample period. Hence, it is important to note that the second stage regressions mostly exploit the cross-sectional dimension, rather than the time-series dimension, of the panel data.

Figure 2. Quantile Overhang Thresholds for Five Country Groups and for All Countries

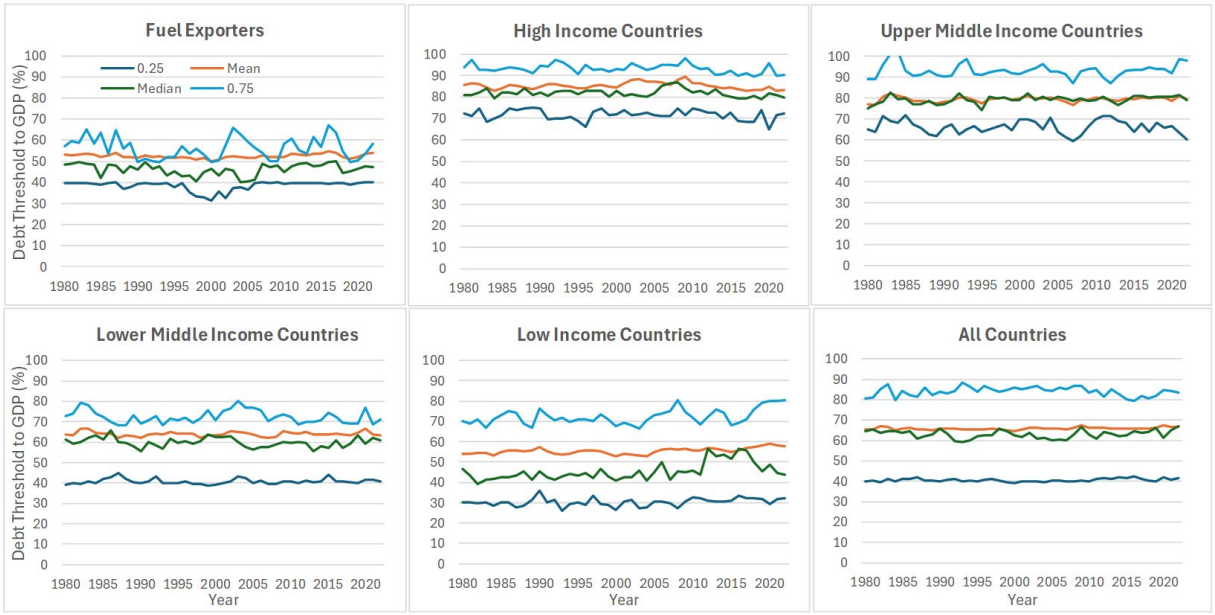


Figure 3 shows the effect of being above/below the estimated debt threshold on growth, which is significant and seems to decrease with country income. Mean regression coefficients for γ_2 and γ_3 for the five country groups are presented in Figure 3 below. A negative γ_2 coefficient indicates that when public debt exceeds its threshold, its effect on economic growth is negative, ceteris paribus. Conversely, a negative γ_3 coefficient implies that when public debt is below its threshold, additional debt stimulates economic growth. These coefficients are negative across all groups and reach their smallest magnitude in the high-income group, where public debt accumulation appears to have a limited impact on economic growth.

Figure 3. Mean Estimates of Debt Threshold Coefficients for Country Groups

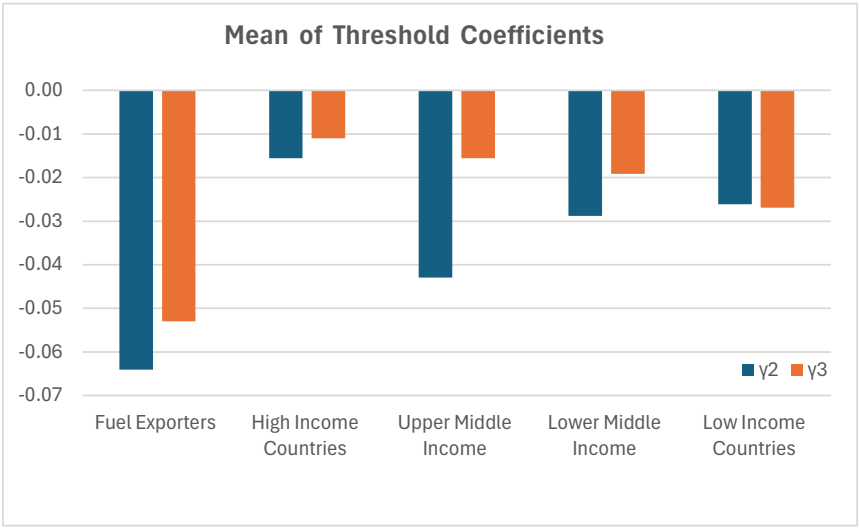
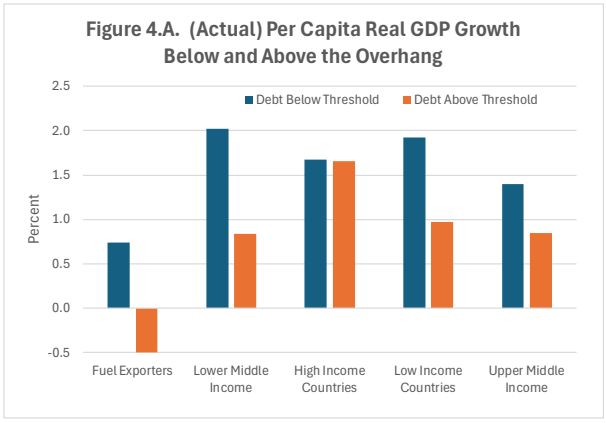


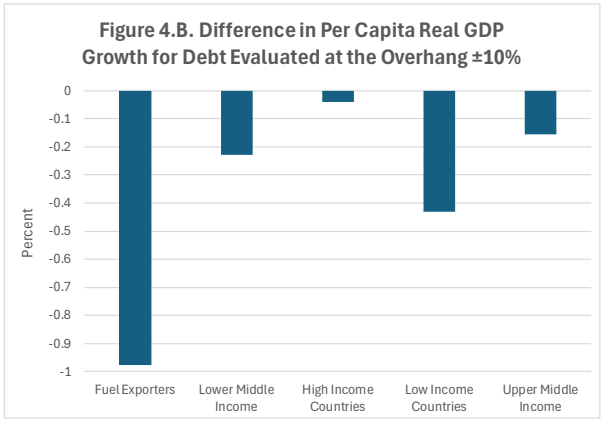
Figure 4.A shows the average per capita GDP growth for five country groups. These averages were calculated separately for periods when a country's public debt exceeded the threshold and when it remained below the threshold. Notably, high-income countries exhibit smaller differences in growth, which can be attributed to the lower values of the gamma coefficients. This plot illustrates the negative impact on GDP growth when a country's public debt to GDP ratio surpasses its threshold.[5]

To better understand the marginal effects of the debt threshold on economic growth, we conducted experiments by varying the threshold by ±10% from its estimated value. Figure 4.B illustrates the differences in the average per capita growth calculated at public debt levels exceeding the estimated threshold by 10 percent from the average per capita growth at public debt levels falling below the estimated threshold by 10 percent across all five income groups. Higher debt levels are associated with a more pronounced economic slowdown, demonstrated by the larger gap in average growth rates before and after surpassing the debt threshold. Except for high-income countries, all groups experience a significant reduction in per capita GDP growth. High-income countries exhibit less sensitivity to changes in debt levels, whereas fuel-exporting and low-income countries show the greatest vulnerability. This stronger debt impact on lower-income countries likely reflects their weaker institutions, limited access to capital markets, and higher borrowing costs.

Finally, it should be noted that estimated debt overhang thresholds reported in Table 1 and Figures 1–3 should not be interpreted as mechanical ceilings beyond which economic growth necessarily declines. Rather, within our state-space framework, the threshold represents a statistically estimated inflection point in the marginal relationship between public debt and per capita GDP growth. More specifically, the estimated threshold identifies the level of the public debt-to-GDP ratio at which the marginal effect of additional debt accumulation on growth changes sign, conditional on the structure of the measurement equation and the observed data. When debt exceeds the estimated threshold, the model implies that the expected marginal effect of further debt accumulation becomes negative. However, this does not imply that growth will necessarily decline in any particular year, as growth outcomes remain influenced by macroeconomic conditions, institutional factors, and external shocks.

Figure 4. Per Capita GDP Growth Below and Above Overhang Threshold for Five Groups





[5] Chi-squared statistics based on Likelihood Ratio tests suggest that γ_2 is significantly different from γ_3 at the 5 percent significance level for all country groups. For the sake of brevity these results are not presented in the paper but are available from the authors upon request.

Baseline Stage 2 Results

We now go on to examine potential factors that could explain the considerable cross-country heterogeneity in the estimated debt overhang thresholds for the whole sample and for the five separate country groups. Note that, since the public debt overhang thresholds are estimated in a first step, the dependent variable for the second stage regressions is derived from generated values that embed model-based assumptions; hence there is an error band of uncertainty associated with these debt overhang threshold estimates, which complicates inference in the second stage. Moreover, due to endogeneity concerns, the estimated relationships should be interpreted as correlations rather than causal effects. The full empirical results for the second stage baseline regressions are presented in Annex 2.

In summary, the results show that payment track record, governance and institutional quality, the composition of public debt (currency, maturity, and creditor base), and the size and development of the domestic financial sector, are all associated with debt overhang thresholds.

More specifically, our empirical results suggest that payment track record is associated with higher debt overhang thresholds, though the size of its impact varies by country group. By explicitly incorporating repayment history into the analysis of debt overhang thresholds, this paper makes a distinct contribution to the literature, where this dimension has received limited direct attention. Stronger law and order and improved bureaucratic quality are consistently associated with higher thresholds, suggesting that institutional strength enhances a country's capacity to sustain public debt without adversely affecting economic growth. This result is in line with previous studies, including Kim et al. (2017) and Gomez-Puig et al (2022), that provide empirical evidence that quality of governance and control of corruption are relevant factors that influence the relationship between public debt and economic growth. Conversely, a greater share of non-resident public debt and of public debt held by official creditors, are associated with a lower threshold, indicating heightened vulnerability to external financing conditions. Related studies, including Schularick and Taylor (2012) and Gomez-Puig et al (2022), further highlight a negative impact of private indebtedness on the debt growth relationship, complementing our findings. We also find that a higher share of short-term external debt in total external debt is linked to a reduced public debt overhang threshold for some country groups, reflecting increased rollover risk (see also Barro, 1979 and Gomez-Puig et al, 2022).

Importantly, our results also provide strong evidence that the size of the domestic financial sector is associated positively with the debt overhang threshold, and this applies both to banks and deposit-taking financial institutions and to nonbank financial corporations. However, capital market size – measured by stock market capitalization and outstanding stock of (public and private) debt securities issuances in percent of GDP – does not seem to have an impact on the estimated thresholds, possibly reflecting the small sample size. Finally, we uncover robust evidence that financial development - encompassing both financial markets and financial institutions - raises the debt overhang threshold, albeit with notable variation across country groups.

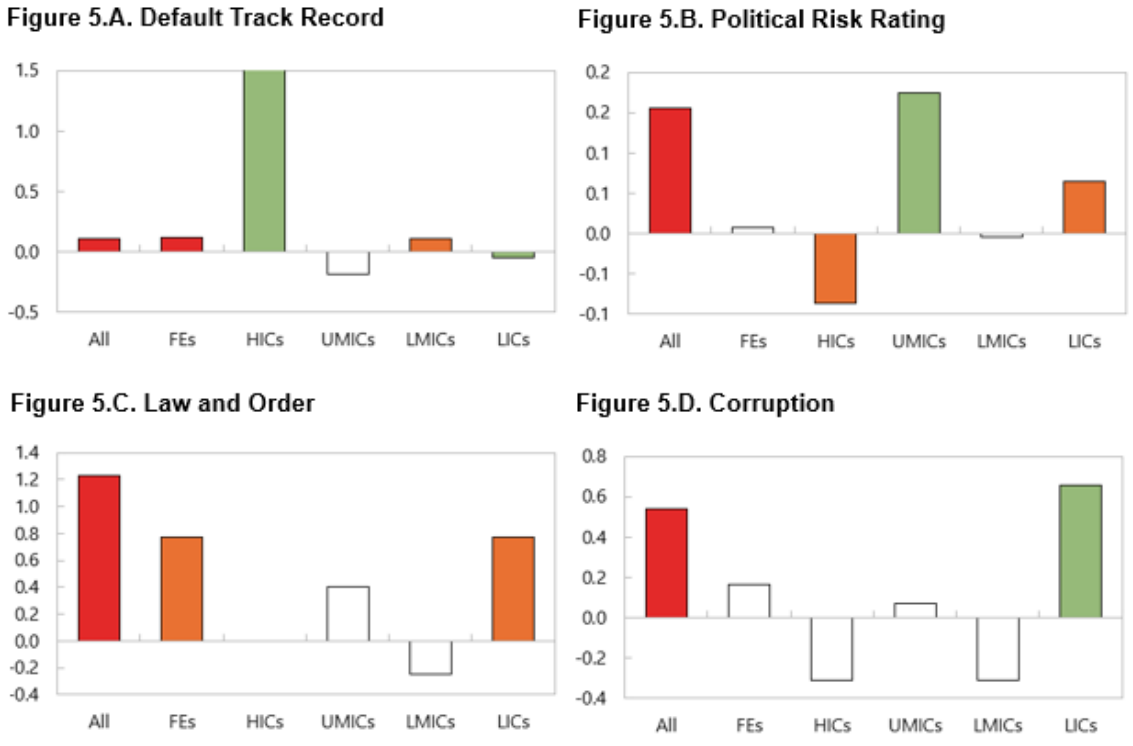
In more detail:

1. Default Track Record and Institutional and Governance variables (Figure 5 and Annex 2 Tables 1, 2A and 2B).

- For the whole sample payment track record, law and order, corruption and bureaucratic quality are statistically associated with variation in debt overhang thresholds. The default track record shows a notable relationship for FEs and LMICs.

- Law and order is linked to debt thresholds for FEs and LICs.
- Corruption is linked to debt thresholds for LICs, although only at the 10 percent level of statistical significance, even though corruption seems highly relevant for the sample as a whole.
- Political Risk Rating and Bureaucratic quality are linked to debt thresholds, but with a counter-intuitive sign for HICs. In particular, we find that better governance is associated with lower debt thresholds in high-income countries, which is surprising and counterintuitive. Moreover, this result contrasts with the broader literature and with our findings for other income groups. This may be because the limited variation in governance scores among high-income countries makes it difficult to identify a clear relationship with public debt.

Figure 5. Default Track Record and Governance (Coefficients and significance)



Source: IMF staff calculations.
Red = 1% significance level; Orange = 5% significance level; Green = 10% significance level; White = Not significant.
All = All sample countries (89 countries); FEs = Fuel Exporters (12 countries); HICs= High Income Countries (24 countries); UMICs = Upper Middle Income Countries (9 countries); LMICs = Lower Middle Income Countries (21 countries); LICs = Low Income Countires (23 countries).

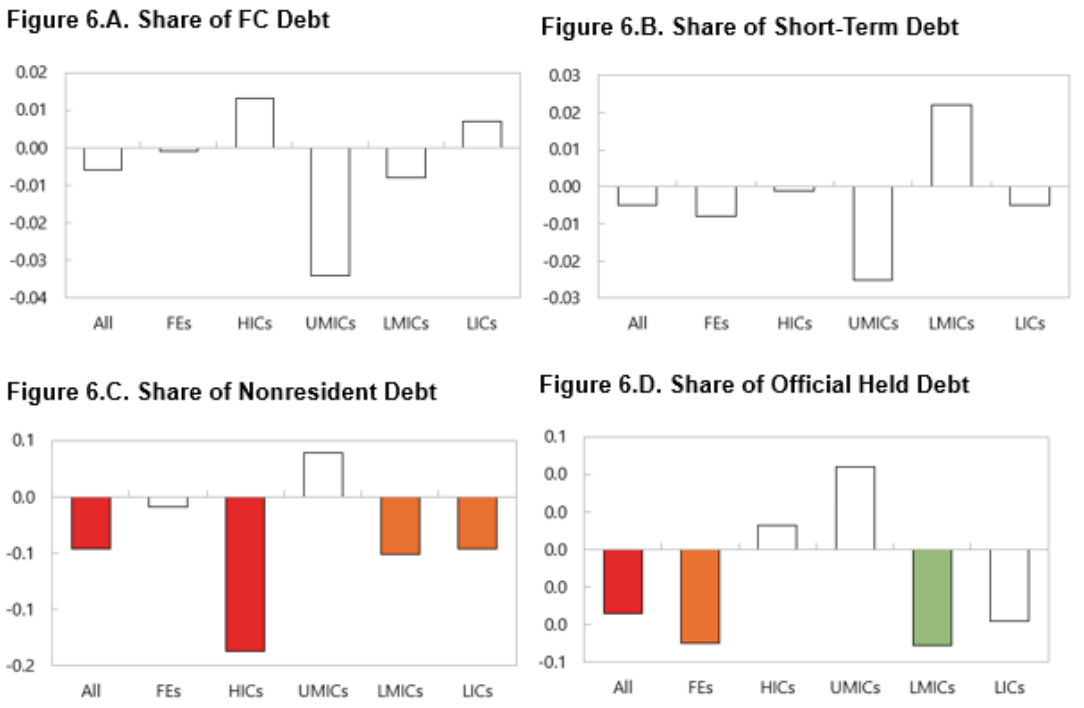
2. Adding Composition of Debt variables (Figure 6 and Annex 2 Tables 3A–3F).

- For the whole sample, the results suggest that a higher share of nonresident public debt, and of public debt held by official creditors, tend to lower the debt overhang threshold.
- There is no evidence that a higher share of short-term external debt in total external debt, or a higher share of foreign currency-denominated public debt, is associated with a lower debt overhang

threshold. These results are contrary to the findings of Gomez-Puig and Sosvilla-Rivero, 2024, and Woo and Kumar, 2015, who find respectively that the marginal impact of public debt on economic growth is affected by the maturity structure and by the currency composition of public debt.

- For FEs the empirical results suggest that a higher share of public debt held by official creditors is associated with a lower debt overhang threshold, and for HICs and LICs the same is the case with a higher share of public debt held by nonresident creditors. However, for HICs we also get the puzzling and counter-intuitive result that better governance and institutional quality tend to lower the debt overhang threshold. As mentioned earlier, this may be because the limited variation in governance scores among high-income countries makes it difficult to identify a clear relationship with public debt.
- Higher shares of both official debt and nonresident debt are associated with a lower debt overhang threshold for LMICs.
- For UMICs there is no consistent evidence that the composition of public debt, or of the sovereign debt creditor base, has any impact on the debt overhang threshold.

Figure 6. Composition of Public Debt (Coefficients and significance)

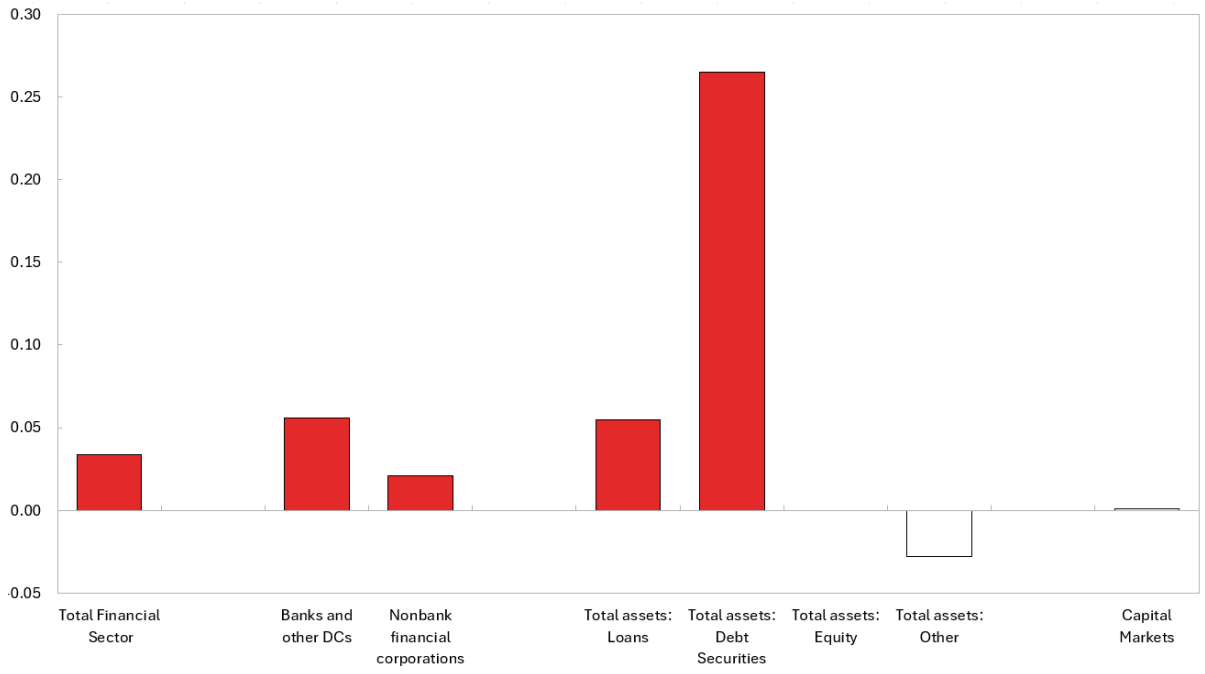


Source: IMF staff calculations.
Red = 1% significance level; Orange = 5% significance level; Green = 10% significance level; White = Not significant.
All = All sample countries (83 countries); FEs = Fuel Exporters (12 countries); HICs= High Income Countries (22 countries); UMICs = Upper Middle Income Countries (8 countries); LMICs = Lower Middle Income Countries (21 countries); LICs = Low Income Countires (20 countries).

3. Adding size of the financial sector (Figure 7 and Annex 2 Table 4)

- The empirical results suggest that the size of the domestic financial sector is positively related to the debt overhang threshold.
- This result holds for both banks and other deposit taking corporations, and for non-bank financial corporations separately.
- Particularly important are financial sector holdings of loans and debt securities.
- The size of the capital market does not appear to have any notable impact on the debt overhang threshold, perhaps reflecting the small sample size (only 22 countries).

Figure 7. Financial Sector Size (Coefficient and Significance)



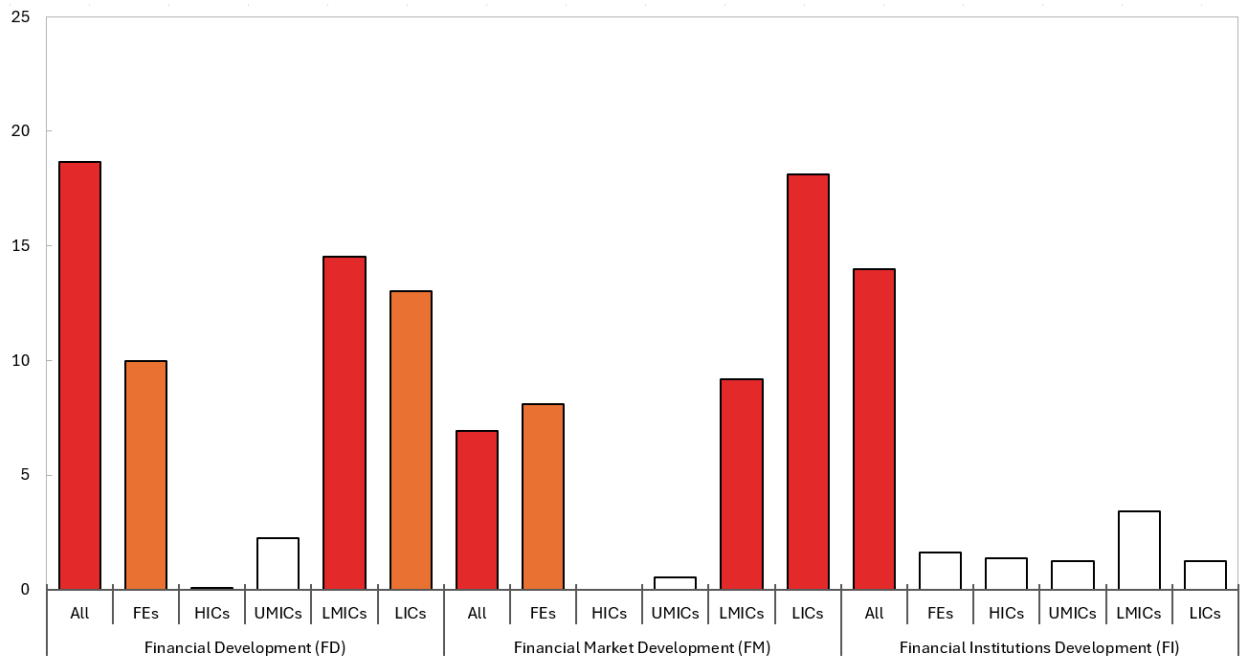
Source: IMF staff calculations.
Red = 1% significance level; Orange = 5% significance level; Green = 10% significance level; White = Not significant.
Sample size is 37 countries, except for capital markets, where the sample size is 22 countries.

4. Adding the Financial Development Index (Figure 8 and Annex 2 Tables 5A–5F)

- The financial development indicators cover a much wider set of characteristics of the domestic financial sector apart from size, including depth, access, and efficiency.
- For the whole sample, the empirical results provide strong evidence that higher levels of financial development, of both financial markets and financial institutions, are associated with a higher debt overhang threshold.

- Overall, financial development is particularly strongly linked to debt thresholds for FEs, LMICs and LICs.
- For FEs, LMICs and LICs financial market development appears to have a statistically significant positive impact on the debt overhang threshold, but this is not the case for development of financial institutions.
- For HICs and UMICs there is no consistent evidence that financial development has any impact on the debt overhang threshold.

Figure 8. Financial Development Indicators (Coefficient and significance)



Source: IMF staff calculations.
Red = 1% significance level; Orange = 5% significance level; Green = 10% significance level; White = Not significant.
All = All sample countries (89 countries); FEs = Fuel Exporters (12 countries); HICs= High Income Countries (24 countries); UMICs = Upper Middle Income Countries (9 countries); LMICs = Lower Middle Income Countries (21 countries); LICs = Low Income Countires (23 countries).

The empirical results are, overall, generally robust and conform with our prior expectations. One important and interesting exception relates to HICs, where we get the puzzling and counter-intuitive result that better governance and institutional quality tend to *lower* the debt overhang threshold. This may be because the limited variation in governance scores among high-income countries makes it difficult to identify a clear relationship with public debt.

Robustness Checks

In this subsection, we present a series of alternatives to the baseline Stage 2 regressions to verify the robustness of the baseline results. Detailed tables of results for the robustness checks are not presented here for the sake of brevity but are available from the authors upon request.

First, we discuss results obtained by combining the feasible generalized least squares (FGLS) procedure with panel-corrected standard errors (PCSEs), following Prais and Winsten, to account for AR(1) serial correlation within countries, as well as heteroskedasticity and cross-sectional dependence across countries, in the second-stage regressions. Then, as a second robustness check, we look at results obtained from re-estimating the model with a smaller variance of the state-equation error term—set to 0.4 rather than 0.7 times the variance of the detrended public debt-to-GDP ratio for each country. We found that, although increasing this variance amplified fluctuations in the debt threshold, its impact on the average values remained relatively modest. Finally, as a third robustness check, we analyze results from re-specifying the state equation to follow a mean-reverting process (Equation 2b) instead of a random walk. Across all exercises, the main results remain broadly consistent with the baseline findings, though with some quantitative differences. In most (but not all) cases, the R-squared and pseudo R-squared values from the baseline GLS regressions are higher than those obtained from the robustness checks.

Under the Prais–Winsten PCSE specification, most coefficients remain stable, though some significance levels change. The default track record variable shows only a weaker relationship for the full sample and no clear pattern for HICs and LMICs. Bureaucratic quality follows the expected pattern for fuel exporters (FEs) but shows no clear relationship for HICs. For the full sample, the share of short-term external debt in total external debt becomes more strongly linked to debt overhang thresholds, and for LMICs a higher share of short-term external debt in total external debt appears to lower the debt overhang threshold. For UMICs a higher share of foreign currency–denominated debt is associated with a lower threshold, while – counter-intuitively - a greater share of public debt held by nonresidents is associated with a higher threshold. Turning to financial sector size, the PCSE results are very similar to the baseline regression results, with two important differences: the size of assets of nonbank financial corporations no longer displays a clear correlation, while higher financial sector holdings of equities and other assets are associated with a lower debt overhang threshold. The results using the financial development indicators also yield very similar conclusions to the baseline results.

Applying a smaller variance to the error term of the state equation does not make much difference to the results. One difference is that the corruption index no longer displays a clear correlation for LICs, even though it still displays a strong correlation for the whole sample. Another difference is that, for LICs, the evidence is less conclusive that overall financial development, and development of financial markets separately, are associated with a lower debt overhang threshold.

Finally, under the mean-reverting specification for state equation, results remain qualitatively similar. However, the corruption index no longer appears linked to the debt threshold, and the default track record variable no longer shows a clear pattern for LMICs. Also, regarding the composition of public debt, for the whole sample there is no longer consistent evidence that a higher share of public debt held by official creditors is associated with a lower debt overhang threshold. The results for financial sector size are very similar to the baseline regression results. However, the financial development indicators no longer show a clear relationship for all individual country groups, with the exception of LMICs.

VI. Conclusions

This paper contributes to the ongoing debate on public debt sustainability by empirically estimating country-specific public debt overhang thresholds - that is, the point beyond which additional public debt accumulation begins to have a negative marginal effect on per capita real GDP growth. Using a Kalman Filter approach applied to a panel of 105 countries, we provide time-varying estimates of these thresholds, offering a more nuanced and dynamic view of the debt-growth relationship than existing cross-country or country group analyses.

Our estimates of the debt overhang thresholds show relatively limited time-variation within most country groups, likely a reflection of the slow movement of many of the underlying structural factors driving these thresholds (e.g., strengthening of institutional quality or deepening of financial markets). The estimated thresholds also illustrate notable responses to crises such as the Global Financial Crisis (GFC) and COVID-19.

At the same time our findings reveal substantial heterogeneity in debt overhang thresholds across countries, underscoring the importance of country-specific factors in determining an economy's debt-carrying capacity. That is, there is considerable variation in the estimated debt overhang thresholds across country groups, with the mean threshold ranging from over 52% of GDP for fuel exporters to around 85% of GDP for high income countries. The country-level estimates vary from a low of 20% of GDP to a high of almost 210% of GDP over the sample period.

To explain heterogeneity in the estimated public debt overhang thresholds, we assess the importance of five broad sets of factors influencing these thresholds: a country's sovereign debt repayment track record, governance and institutional quality, the composition and structure of the stock of public debt (in terms of currency, maturity, and creditor base), the size and structure of domestic financial markets, and the overall level of financial sector development (in terms of both markets and institutions).

Among these, institutional quality - particularly law and order and bureaucratic effectiveness - are consistently associated with a higher debt overhang threshold. A strong track record of debt repayment also seems to play an important role, though its importance varies by country groups. Certain structural characteristics of public debt - such as a higher share of nonresident holdings or short-term external debt – as well as the size of the domestic financial market, and indicators of depth, access, and efficiency of the domestic financial sector, are also shown to be linked to a country's public debt overhang threshold.

It is hoped that the results in this paper will offer useful insights for policymakers seeking to expand the public debt carrying capacity of their economies.

Annex 1. Variables used in Estimation and Data Sources

Summary of Data Used

Variable	Definition	Source
	First Stage	
working age population	Population age 15-64.	IMF World Economic Outlook.
human capital index	Measure based on years of schooling and returns to education.	Penn World Tables v 10.1 with author calculations.
capital stock	Stock of capital from Penn world tables, extended using perpetual inventory method.	Penn World Tables v 10.1 with author calculations.
trade openness	exports and imports as a percentage of GDP.	IMF World Economic Outlook with author calculations.
terms of trade	Ratio of export to import prices.	World Bank World Developmenrt Indicators
public debt to GDP	Debt held by the general government as a share of GDP.	Sovereign investor base estimates by Arslanalp and Tsuda (2014) supplemented with IMF FAD historical public debt data base.
	Second Stage	
default record	A 20 year rolling average of the share of debt in arrears.	BOC-BOE data with author calculations.
political risk rating	Expert assessment of overall political risk.	ICRG database.
composite risk rating	Expert assessment of political, economic and financial risk.	ICRG database.
law and order index	Expert assessment of the impartiality of law as well as popular observance of the law.	ICRG database.
corruption index	Expert assessment of corruption in a country.	ICRG database.
government stability index	Expert assessment of ability of government to maintain power and execute its goals.	ICRG database.
bureaucratic quality index	Expert assessment of bureaucratic expertise.	ICRG database.
share of foreign currency debt	Share of total debt held in foreign currency.	IMF World Economic Outlook with author calculations.
share of short term external debt	Share of external debt with original maturity 1 year or less.	World Bank WDI with author calculations.
share of non resident debt	Share of total debt held by non residents.	Arslanalp and Tsuda with author calculations.
share of official held debt	Share of debt to foreign official creditors and the domestic central bank.	Arslanalp and Tsuda with author calculations.
banking sector	Sum of bank assets.	IMF Monetary and Financial Statistics with author calculations.
Non-bank financial institutions	Sum of pension and insurance company assets.	World Bank Global Financial development Database with author calculations.
capital market size	Sum of stock market capitalization, private debt, and public debt markets.	World Bank Global Financial development Database with author calculations.
non-bank financial sector	Sum of non-bank financial institutions and capital markets.	World Bank Global Financial development Database with author calculations.
total financial sector size	Sum of banking sector and non-bank financial sector.	World Bank Global Financial development Database with author calculations.
FD	Index of overall financial development.	IMF Financial Development Index dataset.
FI	Index of financial institution development.	IMF Financial Development Index dataset.
FM	Index of financial market development.	IMF Financial Development Index dataset.

Annex 2. Baseline Regressions

Annex 2 Table 1. GLS: Payment Track Record - All Countries and Country Groups

VARIABLES	(1) All	(2) FEs	(3) HICs	(4) UMICs	(5) LMICs	(6) LICs
default_record	0.100***	0.125***	4.234**	-0.158	0.230***	-0.128***
	(0.0221)	(0.023)	(2.065)	(0.127)	(0.039)	(0.030)
Constant	54.35***	35.550***	-340.028*	85.461***	39.925***	60.335***
	(2.029)	(2.064)	(206.453)	(12.287)	(3.259)	(2.705)
Observations	3,757	452	948	346	932	1,079
R-squared	0.110	0.236	0.0232	-0.0222	0.120	0.234
Number of Countries	105	13	24	10	26	32

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 2A. GLS: Payment Track Record and ICRG Governance Variables - All Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	0.100***							0.104***
	(0.022)							(0.025)
Political_Risk_Rating		0.155***						
		(0.017)						
Composite_Risk_Rating			0.112***					
			(0.018)					
law_and_order				1.734***				1.232***
				(0.169)				(0.190)
Corruption					1.169***			0.537***
					(0.167)			(0.175)
Government_Stability						0.132**		0.021
						(0.054)		(0.053)
Bureaucracy_Quality							4.141***	2.989***
							(0.281)	(0.321)
Constant	54.353***	52.805***	55.543***	56.515***	59.309***	61.950***	53.651***	40.656***
	(2.029)	(1.221)	(1.286)	(0.809)	(0.737)	(0.632)	(0.884)	(2.388)
Observations	3,757	3,448	3,448	3,449	3,449	3,449	3,449	3,148
R-squared	0.110	0.232	0.220	0.235	0.221	0.204	0.280	0.323
Number of Countries	105	89	89	89	89	89	89	89

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 2B. GLS: Payment Trac Record and ICRG Governance Variables - Country Groups

VARIABLES	(1) FEs	(2) FEs	(3) FEs	(4) HICs	(5) HICs	(6) HICs	(7) UMICs	(8) UMICs	(9) UMICs	(10) LMICs	(11) LMICs	(12) LMICs	(13) LICs	(14) LICs	(15) LICs
default_record	0.125***	0.096***	0.116***	4.234**	5.111**	4.397*	-0.158	-0.182	-0.183	0.230***	0.144***	0.112**	-0.128***	-0.052*	-0.051*
	(0.023)	(0.030)	(0.032)	(2.065)	(2.286)	(2.260)	(0.127)	(0.135)	(0.132)	(0.039)	(0.040)	(0.052)	(0.030)	(0.031)	(0.030)
Political_Risk_Rating		0.008			-0.086**			0.174*			-0.004			0.064**	
		(0.029)			(0.043)			(0.099)			(0.028)			(0.031)	
law_and_order			0.773**			-0.000			0.405			-0.247			0.772**
			(0.305)			(0.509)			(0.832)			(0.293)			(0.343)
Corruption			0.163			-0.312			0.069			-0.313			0.657*
			(0.368)			(0.343)			(0.699)			(0.300)			(0.376)
Government_Stability			-0.061			0.068			0.024			0.085			0.050
			(0.082)			(0.099)			(0.253)			(0.103)			(0.090)
Bureaucracy_Quality			0.601			-4.081***			1.447			0.429			0.535
			(0.412)			(1.182)			(1.433)			(0.587)			(0.531)
Constant	35.550***	36.610***	32.338***	-340.028*	-420.594*	-339.609	85.461***	76.958***	84.456***	39.925***	48.646***	49.357***	60.335***	51.913***	50.480***
	(2.064)	(3.052)	(3.135)	(206.453)	(228.447)	(225.838)	(12.287)	(14.237)	(13.016)	(3.259)	(4.053)	(4.893)	(2.705)	(3.422)	(3.061)
Observations	452	410	410	948	892	892	346	300	301	932	763	763	1,079	782	782
R-squared	0.236	0.224	0.270	0.0232	0.107	0.103	-0.0222	0.0802	0.0937	0.120	0.281	0.269	0.234	0.476	0.482
Number of Countries	13	12	12	24	24	24	10	9	9	26	21	21	32	23	23

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 3A. GLS: Adding Public Debt and Debtholder Composition Variables - All Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold
default_record	0.249***	0.225***	0.243***	0.145***	0.124***	0.108***
	(0.0266)	(0.027)	(0.030)	(0.026)	(0.026)	(0.029)
Political_Risk_Rating	0.213***	0.244***	0.300***			
	(0.0209)	(0.024)	(0.025)			
law_and_order				1.609***	1.627***	1.590***
				(0.226)	(0.246)	(0.311)
Corruption				0.541***	0.451**	0.066
				(0.203)	(0.219)	(0.253)
Government_Stability				-0.009	-0.015	-0.044
				(0.063)	(0.072)	(0.088)
Bureaucracy_Quality				4.354***	5.351***	7.217***
				(0.384)	(0.420)	(0.480)
share_fc_debt	-0.00830	-0.006	-0.006	-0.006	-0.000	0.006
	(0.00571)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
share_shortexternal	-0.0221*	-0.027*	-0.045***	-0.005	-0.005	0.009
	(0.0131)	(0.015)	(0.016)	(0.013)	(0.015)	(0.016)
share_nonresident_debt		-0.054***			-0.046***	
		(0.012)			(0.011)	
share_official_held_debt			-0.079***			-0.034***
			(0.014)			(0.012)
Constant	30.96***	32.587***	29.508***	33.997***	35.444***	33.744***
	(2.785)	(2.979)	(3.299)	(2.543)	(2.620)	(3.036)
Observations	2,604	2,210	1,816	2,605	2,210	1,816
R-squared	0.407	0.548	0.592	0.434	0.574	0.612
Number of Countries	83	81	80	83	81	80

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 3B. GLS: Adding Public Debt and Debtholder Composition Variables - Fuel Exporters

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold
default_record	0.0802***	0.113***	0.166***	0.109***	0.144***	0.129**
	(0.0298)	(0.032)	(0.046)	(0.036)	(0.041)	(0.059)
Political_Risk_Rating	0.00105	0.028	0.299***			
	(0.0266)	(0.039)	(0.099)			
law_and_order				0.698**	1.133***	3.636***
				(0.306)	(0.428)	(0.807)
Corruption				0.075	0.247	0.206
				(0.360)	(0.499)	(0.743)
Government_Stability				-0.051	-0.068	-0.227
				(0.081)	(0.128)	(0.226)
Bureaucracy_Quality				0.862**	1.296**	8.523***
				(0.420)	(0.603)	(1.717)
share_fc_debt	-0.00497	-0.009	-0.020	-0.011	-0.014	-0.000
	(0.00742)	(0.012)	(0.026)	(0.009)	(0.014)	(0.024)
share_shortexternal	0.00614	-0.000	-0.043	-0.008	-0.021	-0.064
	(0.0189)	(0.025)	(0.057)	(0.023)	(0.032)	(0.055)
share_nonresident_debt		-0.008			-0.009	
		(0.016)			(0.020)	
share_official_held_debt			-0.049**			-0.050**
			(0.023)			(0.025)
Constant	38.29***	35.445***	20.921***	33.477***	30.149***	16.745**
	(3.029)	(3.645)	(7.115)	(3.568)	(4.318)	(6.884)
Observations	386	331	236	386	331	236
R-squared	0.311	0.347	0.561	0.359	0.416	0.669
Number of Countries	12	12	11	12	12	11

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 3C. GLS: Adding Public Debt and Debtholder Composition Variables - High Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold
default_record	5.966*	6.362**	7.517*	5.639	4.450	6.323
	(3.419)	(3.219)	(4.114)	(3.831)	(3.252)	(4.346)
Political_Risk_Rating	-0.131***	-0.167**	-0.205***			
	(0.0464)	(0.068)	(0.070)			
law_and_order				-0.064	-0.534	-1.043
				(0.528)	(0.709)	(0.891)
Corruption				-0.969**	-0.811	-1.165*
				(0.409)	(0.546)	(0.620)
Government_Stability				0.020	0.141	0.231
				(0.111)	(0.150)	(0.181)
Bureaucracy_Quality				-6.369***	-5.307***	-5.597***
				(1.095)	(1.521)	(1.728)
share_fc_debt	0.0122	-0.014	0.007	0.013	-0.004	0.015
	(0.0111)	(0.014)	(0.014)	(0.012)	(0.014)	(0.015)
share_shortexternal	2.68e-05	0.001	-0.009	-0.001	0.009	-0.008
	(0.0246)	(0.030)	(0.034)	(0.028)	(0.029)	(0.036)
share_nonresident_debt		-0.179***			-0.137***	
		(0.035)			(0.035)	
share_official_held_debt			-0.024			0.013
			(0.035)			(0.039)
Constant	-500.7	-529.007	-647.822	-449.738	-328.770	-517.641
	(341.8)	(321.938)	(411.529)	(383.149)	(325.308)	(434.884)
Observations	746	535	509	746	535	509
R-squared	0.182	0.561	0.349	0.188	0.552	0.348
Number of Countries	22	20	21	22	20	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 3D. GLS: Adding Public Debt and Debtholder Composition Variables - Upper Middle Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold
default_record	-0.202*	-0.226	-0.135	-0.197	-0.280	-0.332**
	(0.120)	(0.139)	(0.152)	(0.134)	(0.187)	(0.152)
Political_Risk_Rating	0.253**	0.305**	0.048			
	(0.107)	(0.147)	(0.126)			
law_and_order				1.064	1.597	0.565
				(0.903)	(1.403)	(1.207)
Corruption				-0.135	-0.595	0.008
				(0.745)	(1.130)	(0.965)
Government_Stability				0.111	0.134	-0.212
				(0.275)	(0.410)	(0.353)
Bureaucracy_Quality				1.914	8.130***	17.633***
				(1.488)	(3.077)	(3.705)
share_fc_debt	-0.0285	-0.027	-0.022	-0.034	-0.031	-0.138***
	(0.0220)	(0.025)	(0.040)	(0.024)	(0.029)	(0.050)
share_shortexternal	-0.0475	-0.097	0.008	-0.025	-0.062	-0.003
	(0.0721)	(0.104)	(0.093)	(0.077)	(0.117)	(0.104)
share_nonresident_debt		0.007			0.039	
		(0.082)			(0.091)	
share_official_held_debt			-0.055			0.044
			(0.077)			(0.094)
Constant	77.62***	76.063***	79.366***	85.729***	75.351***	61.932***
	(13.26)	(16.514)	(17.604)	(13.212)	(18.678)	(16.049)
Observations	266	204	184	267	204	184
R-squared	0.256	0.521	0.462	0.268	0.566	0.596
Number of Countries	8	8	8	8	8	8

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 3E. GLS: Adding Public Debt and Debtholder Composition Variables - Lower Middle Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold
default_record	0.201***	0.188***	0.285***	0.185***	0.179***	0.284***
	(0.0485)	(0.052)	(0.047)	(0.059)	(0.063)	(0.066)
Political_Risk_Rating	-0.0142	0.008	-0.008			
	(0.0420)	(0.042)	(0.056)			
law_and_order				0.090	0.372	0.646
				(0.407)	(0.455)	(0.642)
Corruption				-0.421	-0.457	-0.203
				(0.352)	(0.379)	(0.492)
Government_Stability				0.039	0.034	-0.005
				(0.129)	(0.144)	(0.206)
Bureaucracy_Quality				0.340	0.698	3.655***
				(0.838)	(0.872)	(1.179)
share_fc_debt	-0.0108	-0.008	-0.004	-0.008	-0.006	0.001
	(0.00900)	(0.009)	(0.010)	(0.010)	(0.011)	(0.016)
share_shortexternal	0.0175	0.013	0.022	0.022	0.018	0.037
	(0.0247)	(0.025)	(0.027)	(0.026)	(0.028)	(0.036)
share_nonresident_debt		-0.043**			-0.051**	
		(0.018)			(0.020)	
share_official_held_debt			-0.080***			-0.051*
			(0.023)			(0.031)
Constant	45.99***	47.097***	41.199***	44.343***	45.846***	29.242***
	(5.457)	(5.775)	(6.387)	(5.803)	(6.335)	(7.184)
Observations	673	623	454	673	623	454
R-squared	0.342	0.404	0.624	0.334	0.403	0.637
Number of Countries	21	21	20	21	21	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 3F. GLS: Adding Public Debt and Debtholder Composition Variables - Low Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold
default_record	-0.00396	0.002	-0.027	0.004	0.009	-0.018
	(0.0428)	(0.042)	(0.050)	(0.048)	(0.047)	(0.056)
Political_Risk_Rating	-0.0424	-0.000	-0.030			
	(0.0614)	(0.064)	(0.080)			
law_and_order				1.494**	1.829***	1.954**
				(0.599)	(0.592)	(0.768)
Corruption				-0.279	0.041	-0.121
				(0.744)	(0.735)	(0.867)
Government_Stability				-0.350*	-0.329	-0.387
				(0.208)	(0.205)	(0.256)
Bureaucracy_Quality				2.514**	2.104*	2.253**
				(1.071)	(1.097)	(1.099)
share_fc_debt	0.0103	0.025	-0.001	0.007	0.025	0.012
	(0.0190)	(0.020)	(0.023)	(0.016)	(0.017)	(0.018)
share_shortexternal	-0.0156	-0.051	-0.032	-0.005	-0.042	-0.024
	(0.0534)	(0.056)	(0.066)	(0.046)	(0.047)	(0.048)
share_nonresident_debt		-0.048**			-0.046**	
		(0.024)			(0.022)	
share_official_held_debt			-0.045			-0.038
			(0.030)			(0.026)
Constant	51.13***	50.153***	55.789***	45.602***	45.097***	48.440***
	(5.361)	(5.422)	(6.877)	(5.327)	(5.377)	(6.552)
Observations	533	517	433	533	517	433
R-squared	0.620	0.633	0.706	0.642	0.652	0.721
Number of Countries	20	20	20	20	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 4. GLS: Adding Financial Sector Size - All Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	-0.115	-0.166**	-0.158**	0.204***	-0.128**	-0.168***	-0.311***	0.067
	(0.072)	(0.069)	(0.073)	(0.076)	(0.057)	(0.062)	(0.069)	(0.103)
Political_Risk_Rating	0.180***	0.066	0.122**	0.216***				
	(0.046)	(0.050)	(0.055)	(0.053)				
Total_financial_sector	0.052***				0.034***			
	(0.007)				(0.006)			
Banks_and_other_DCs		0.109***				0.056***		
		(0.015)				(0.015)		
Nonbank_financial_corporations		0.021**				0.021***		
		(0.008)				(0.007)		
Total_assets_loans			0.088***				0.055**	
			(0.023)				(0.024)	
Total_assets_debt_securities			0.227***				0.265***	
			(0.036)				(0.037)	
Total_assets_equity			-0.020				-0.000	
			(0.025)				(0.025)	
Total_assets_other			-0.012				-0.028	
			(0.024)				(0.024)	
capital_market				0.003				0.001
				(0.004)				(0.004)
law_and_order					0.338	0.237	-0.218	2.587***
					(0.434)	(0.505)	(0.577)	(0.685)
Corruption					0.187	0.360	-0.147	-0.640
					(0.390)	(0.447)	(0.524)	(0.526)
Government_Stability					-0.089	-0.084	0.032	-0.038
					(0.109)	(0.130)	(0.183)	(0.164)
Bureaucracy_Quality					11.231***	10.910***	10.483***	6.419***
					(1.148)	(1.273)	(1.312)	(1.547)
Constant	47.806***	54.767***	49.815***	35.301***	35.104***	38.264***	48.632***	37.631***
	(7.073)	(7.192)	(7.431)	(7.716)	(5.390)	(6.057)	(6.326)	(10.023)
Observations	551	551	551	431	551	551	551	431
R-squared	0.879	0.884	0.912	0.875	0.895	0.897	0.928	0.882
Number of Countries	37	37	37	22	37	37	37	22

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 5A. GLS : Adding Financial Development Indicators - All Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	0.0870***	0.089***	0.124***	0.081***	0.060**	0.058**	0.088***	0.053**
	(0.0226)	(0.023)	(0.024)	(0.023)	(0.024)	(0.024)	(0.025)	(0.024)
Political_Risk_Rating	0.0958***	0.115***	0.115***	0.096***				
	(0.0163)	(0.016)	(0.017)	(0.016)				
law_and_order					0.993***	1.005***	1.156***	0.946***
					(0.190)	(0.186)	(0.196)	(0.187)
Corruption					0.516***	0.549***	0.509***	0.520***
					(0.176)	(0.174)	(0.181)	(0.175)
Government_Stability					-0.019	0.010	-0.019	-0.013
					(0.053)	(0.052)	(0.055)	(0.053)
Bureaucracy_Quality					2.004***	2.251***	2.457***	1.940***
					(0.310)	(0.314)	(0.322)	(0.308)
FD	19.29***				18.657***			
	(1.641)				(1.689)			
FI		18.409***		15.209***		16.536***		13.985***
		(1.639)		(1.712)		(1.701)		(1.776)
FM			9.625***	6.960***			9.295***	6.942***
			(1.159)	(1.145)			(1.172)	(1.169)
Constant	41.92***	40.345***	41.318***	41.274***	41.050***	40.516***	40.846***	40.919***
	(2.236)	(2.237)	(2.369)	(2.219)	(2.250)	(2.222)	(2.359)	(2.219)
Observations	3,063	3,063	3,063	3,063	3,064	3,064	3,064	3,064
R-squared	0.341	0.342	0.320	0.347	0.362	0.361	0.350	0.365
Number of Countries	89	89	89	89	89	89	89	89

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 5B. GLS : Adding Financial Development Indicators - Fuel Exporters

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	0.0676**	0.092***	0.078***	0.075***	0.098***	0.098***	0.108***	0.099***
	(0.0283)	(0.030)	(0.028)	(0.028)	(0.030)	(0.032)	(0.030)	(0.031)
Political_Risk_Rating	0.00193	0.007	0.004	0.004				
	(0.0240)	(0.030)	(0.025)	(0.025)				
law_and_order					0.690**	0.632**	1.044***	0.635**
					(0.277)	(0.276)	(0.350)	(0.277)
Corruption					0.215	0.169	0.316	0.173
					(0.340)	(0.342)	(0.423)	(0.342)
Government_Stability					-0.074	-0.068	-0.082	-0.069
					(0.077)	(0.076)	(0.096)	(0.077)
Bureaucracy_Quality					0.498	0.467	0.844*	0.507
					(0.367)	(0.372)	(0.471)	(0.369)
FD	5.646				9.980**			
	(3.940)				(4.761)			
FI		1.985		1.650		3.158		1.607
		(3.444)		(3.036)		(3.475)		(3.571)
FM			5.149	4.831			14.676***	8.113**
			(3.555)	(3.647)			(4.353)	(4.024)
Constant	38.20***	36.352***	37.889***	37.683***	32.481***	33.456***	30.593***	33.245***
	(2.804)	(3.020)	(2.827)	(2.817)	(2.756)	(3.036)	(2.930)	(2.900)
Observations	399	399	399	399	399	399	399	399
R-squared	0.264	0.247	0.281	0.280	0.326	0.281	0.403	0.341
Number of Countries	12	12	12	12	12	12	12	12

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 5C. GLS : Adding Financial Development Indicators - High Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	5.743**	5.359**	5.462**	5.628**	4.709*	4.683*	4.682*	4.679*
	(2.530)	(2.463)	(2.468)	(2.524)	(2.445)	(2.457)	(2.449)	(2.452)
Political_Risk_Rating	-0.0911**	-0.080*	-0.087*	-0.086*				
	(0.0451)	(0.043)	(0.044)	(0.045)				
law_and_order					-0.010	-0.028	-0.016	-0.030
					(0.524)	(0.521)	(0.523)	(0.524)
Corruption					-0.276	-0.253	-0.292	-0.264
					(0.349)	(0.346)	(0.348)	(0.349)
Government_Stability					0.057	0.060	0.058	0.061
					(0.100)	(0.099)	(0.100)	(0.100)
Bureaucracy_Quality					-3.830***	-3.810***	-3.866***	-3.771***
					(1.186)	(1.180)	(1.184)	(1.187)
FD	0.442				0.085			
	(2.179)				(2.273)			
FI		1.976		2.543		1.192		1.390
		(2.559)		(2.688)		(2.686)		(2.762)
FM			-0.341	-0.611			-0.293	-0.414
			(1.368)	(1.404)			(1.424)	(1.448)
Constant	-483.8*	-447.463*	-455.556*	-473.882*	-372.100	-370.360	-368.822	-369.966
	(252.9)	(246.146)	(246.683)	(252.206)	(244.419)	(245.578)	(244.819)	(245.044)
Observations	868	868	868	868	868	868	868	868
R-squared	0.128	0.128	0.127	0.128	0.123	0.124	0.123	0.123
Number of Countries	24	24	24	24	24	24	24	24

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 5D. GLS : Adding Financial Development Indicators - Upper Middle Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	-0.168	-0.173	-0.173	-0.166	-0.183	-0.180	-0.184	-0.180
	(0.134)	(0.136)	(0.133)	(0.137)	(0.135)	(0.138)	(0.131)	(0.137)
Political_Risk_Rating	0.178*	0.177*	0.174*	0.174*				
	(0.101)	(0.102)	(0.100)	(0.101)				
law_and_order					0.381	0.322	0.421	0.352
					(0.862)	(0.846)	(0.863)	(0.856)
Corruption					0.100	0.144	0.013	0.148
					(0.719)	(0.706)	(0.723)	(0.712)
Government_Stability					0.020	0.021	0.016	0.021
					(0.263)	(0.255)	(0.266)	(0.260)
Bureaucracy_Quality					1.292	1.243	1.467	1.213
					(1.530)	(1.473)	(1.538)	(1.539)
FD	-2.239				2.255			
	(9.435)				(9.605)			
FI		-0.769		-1.240		1.805		1.252
		(9.778)		(10.075)		(9.726)		(10.097)
FM			-0.954	-1.274			2.427	0.524
			(6.247)	(6.424)			(6.647)	(6.862)
Constant	77.72***	77.317***	77.455***	77.714***	84.824***	84.332***	84.819***	84.779***
	(14.09)	(14.153)	(14.063)	(14.189)	(13.184)	(13.402)	(12.868)	(13.344)
Observations	291	291	291	291	292	292	292	292
R-squared	0.114	0.112	0.112	0.113	0.125	0.120	0.126	0.123
Number of Countries	9	9	9	9	9	9	9	9

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 5E. GLS : Adding Financial Development Indicators - Lower Middle Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	0.101**	0.090*	0.135***	0.117**	0.138**	0.141**	0.164***	0.168***
	(0.0501)	(0.051)	(0.050)	(0.054)	(0.056)	(0.060)	(0.056)	(0.061)
Political_Risk_Rating	-0.0293	-0.004	-0.039	-0.032				
	(0.0312)	(0.030)	(0.031)	(0.032)				
law_and_order					-0.364	-0.291	-0.442	-0.414
					(0.329)	(0.326)	(0.324)	(0.336)
Corruption					-0.276	-0.318	-0.334	-0.307
					(0.316)	(0.319)	(0.313)	(0.320)
Government_Stability					0.027	0.086	0.040	0.034
					(0.112)	(0.111)	(0.109)	(0.113)
Bureaucracy_Quality					0.292	0.380	0.454	0.367
					(0.585)	(0.606)	(0.593)	(0.595)
FD	13.96***				14.534***			
	(3.965)				(4.416)			
FI		6.639		4.258		5.722		3.418
		(4.295)		(4.404)		(4.995)		(5.079)
FM			8.487***	8.234***			8.722***	9.189***
			(2.413)	(2.510)			(2.717)	(2.804)
Constant	47.09***	49.028***	47.325***	46.700***	43.231***	45.111***	43.200***	41.855***
	(4.887)	(4.808)	(4.848)	(4.893)	(5.101)	(5.193)	(5.265)	(5.191)
Observations	742	742	742	742	742	742	742	742
R-squared	0.283	0.285	0.282	0.282	0.294	0.293	0.289	0.295
Number of Countries	21	21	21	21	21	21	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 2 Table 5F. GLS : Adding Financial Development Indicators - Low Income Countries

VARIABLES	(1) Threshold	(2) Threshold	(3) Threshold	(4) Threshold	(5) Threshold	(6) Threshold	(7) Threshold	(8) Threshold
default_record	-0.0910**	-0.062*	-0.099***	-0.100***	-0.071**	-0.056*	-0.075**	-0.073**
	(0.0382)	(0.033)	(0.038)	(0.039)	(0.035)	(0.031)	(0.035)	(0.035)
Political_Risk_Rating	0.0336	0.065*	0.044	0.041				
	(0.0406)	(0.034)	(0.040)	(0.041)				
law_and_order					0.622	0.740**	0.765*	0.717*
					(0.414)	(0.370)	(0.391)	(0.401)
Corruption					0.807*	0.710*	0.838**	0.816**
					(0.422)	(0.389)	(0.414)	(0.412)
Government_Stability					0.027	0.042	0.021	0.025
					(0.109)	(0.095)	(0.106)	(0.106)
Bureaucracy_Quality					1.107*	0.751	0.780	0.789
					(0.598)	(0.555)	(0.589)	(0.587)
FD	24.48***				13.008**			
	(6.320)				(5.940)			
FI		3.772		3.176		1.981		1.230
		(3.974)		(4.529)		(3.557)		(3.644)
FM			25.269***	25.599***			18.086***	18.102***
			(6.047)	(6.074)			(6.523)	(6.569)
Constant	53.67***	52.049***	55.257***	54.889***	50.147***	50.138***	50.933***	50.708***
	(4.343)	(3.670)	(4.346)	(4.383)	(3.565)	(3.196)	(3.536)	(3.555)
Observations	763	763	763	763	763	763	763	763
R-squared	0.507	0.491	0.512	0.513	0.506	0.496	0.512	0.512
Number of Countries	23	23	23	23	23	23	23	23

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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PUBLICATIONS

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