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Alberto Isgut

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
DEPARTMENT OF ECONOMICS

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Alberto Isgut, PhD, Individual Consultant and Affiliated Researcher at the Stockholm Environment Institute, Asia Center, Bangkok, Thailand, aisgut@outlook.com

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International Economics and Development Laboratory (IEDL), University of Athens, Greece

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ABSTRACT

The risks posed by issuing debt denominated in a foreign currency are well understood: if the domestic currency depreciates, the local currency cost of servicing such debt will increase. But what has been the recent experience of developing countries? This paper provides a quantitative assessment of the additional cost of servicing foreign currency denominate debt using both data on individual sovereign and subnational bonds and data from the World bank's International Debt Statistics database. The paper also explores whether such additional costs, which are due to depreciation of the exchange rate, have an adverse effect on fiscal space.

Keywords: Sovereign debt, developing countries, foreign currency denominated debt, currency risk, fiscal space.

JEL: F34, H63, E62, G15, O23.

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1. Introduction

Issuing foreign currency denominated debt is risky for governments because a currency depreciation increases the local currency value of both interest payments and principal and, therefore, the cost of servicing and refinancing such debt. Although foreign currency denominated debt protects foreign lenders from currency risk, it can contribute to default risk if a large depreciation creates difficulties for borrowers to continue servicing it (Panizza and Taddei, 2020). Given these risks, it is not surprising that developing countries have traditionally assigned a high priority to preserving the stability of their exchange rates, a phenomenon referred to as "fear of floating" (Calvo and Reinhart, 2002).

A solution to minimize these risks would be to issue debt denominated in local currency. In Asia, for example, the devastating impacts of the debt crisis of 1997-1998 created an impetus for the development of local currency bond markets (Park, 2016). Local currency bond markets, however, do not eliminate currency risk entirely: they merely shift it to international investors that participate in such markets. As such, an important objective in many developing countries has been to expand the local demand for local currency bonds, particularly from institutional investors such as pension funds and insurance companies (IMF and World Bank, 2016; ADB, 2013).

To support the development of local currency bond markets, developing countries also have made efforts to enhance the participation of international investors. However, to reduce their currency risk, such efforts need to be complemented with credible policies to preserve exchange rate stability (Velandia and Secunho, 2020). Yet, as noted by Hausmann (1999), many countries with a history of effective monetary and financial histories still have had difficulties is attracting international investors to local currency bond markets – a phenomenon he referred to as the "original sin" hypothesis. A plausible explanation of the original sin is the small size and illiquidity of most developing countries' local currency bond markets. This explanation is validated by the fact that large countries have been more able to attract foreign investors to their local currency bond markets (Eichengreen et al., 2023).

Because of the original sin, many developing countries' governments continue relying on foreign currency denominated debt. The risks posed for such debt have not escaped the scrutiny of credit rating agencies. For instance, Moody's considers the stock of foreign currency sovereign debt to GDP ratio as an indicator of "the susceptibility of a sovereign's fiscal strength to a currency depreciation," with higher values of this indicator increasing the potential impact of currency depreciation on the debt burden and debt affordability (Moody's Ratings, 2022). Moreover, some studies have found that greater ratios of foreign currency debt to total debt are associated with increased risks of currency and debt crises (Bordo, Meissner, and Stuckler, 2010). In sum, a heavy reliance on foreign currency denominated debt can not only increase the risk of financial losses in case of currency devaluation but also contribute to a deterioration of a country's sovereign credit rating and a consequent increase in the cost of finance (Isgut, 2024).

In sum, the risks posed by issuing debt denominated in a foreign currency are well understood, but what has the recent experience of developing countries with foreign currency denominated public debt been? And how much has currency depreciation contributed to increasing the local currency cost of servicing such debt? This paper seeks to answer these questions using a novel dataset on bond debt of the general government, data on 832 individual foreign currency denominated bonds issued by 54 developing countries, and data from the World bank's International Debt Statistics database. A particularly important question is whether such additional debt servicing costs have had an adverse effect on fiscal space in developing countries. To answer this question, the paper estimates a series of regressions using a simple indicator of fiscal space as dependent variable and debt-to-GDP, revenue-to-GDP, net interest rate, and exchange rate depreciation as explanatory variables.

2. The "original sin" and its consequences

The analysis in this section is based on a novel database of debt of the general government built from data on bond issuances by sovereigns and subnational governments of 93 countries during the period 1 January 2010 – 31 May 2024 (Isgut, 2025b). The 93 countries in the database exclude

countries in North America, Western Europe and the European Union, and countries with data on less than 30 bonds in the period considered.[1]

The sovereign bond debt of country c at time t is measured as the sum of the nominal values, converted to local currency units, of all the active bonds b issued by country c as of time t:

$$(1)\ Debt_{ct} = \sum_b \left(\frac{LCU_c}{CD_b}\right)_t (Nominal\ Value)_t^{bc}, \text{ for } t_0^{bc} \leq t \leq t_m^{bc},$$

where t_0^{bc} and t_m^{bc} are, respectively, the issue date and the maturity date of bond b issued by country c, $(Face\ Value)_t^{bc}$ is the face value of bond b issued by country c as of time t, and $\left(\frac{LCU_c}{CD_b}\right)_t$ is the exchange rate as of time t to convert the currency of denomination of the bond into local currency units.[2] Although this definition can be implemented with a daily periodicity, to reduce computational burden, bonds' issue dates and maturity dates were aggregated monthly. As a result, the database covers 173 months between January 2010 and May 2024. To capture the accumulation of sovereign bond debts as of January 2010, the raw data to build the database includes all sovereign bonds issued before 1 January 2010 that matured at or after 1 January 2010.

According to IMF (2011), the nominal value of a debt instrument is the amount that the debtor owes the creditor at any moment in time according to their debt contract. The underlying data on which the debt database is built consists of 151,663 sovereign and subnational bonds, of which 97.2 per cent are of four types: plain vanilla fixed coupon bonds, discount bonds, pay at maturity fixed bonds, and zero-coupon bonds. The debt database is built on these four types of bonds because they provide enough information to compute nominal values. Namely, for plain vanilla fixed coupon bonds, discount bonds, and zero-coupon bonds, the nominal value is equal, simply, to the face value of the bond, while for pay at maturity

[1] Venezuela was excluded because its economic and financial data was either unavailable or unreliable during and after the country's hyperinflation of 2016-2019.

[2] This formulation accommodates both bonds denominated in foreign currency such as USD (in which case $CD_b = USD$) and local currency denominated bonds (in which case $CD_b = LCU_c$).

fixed bonds, the nominal value is equal to the face value plus the accrued interest since the time of issuance.

Because only a limited number of bills (bonds with a tenor of one year or less) are issued in foreign currency, the analysis is based on sovereign and subnational bonds of a tenor of more than one year. China is excluded because of its very large share of debt within the group of developing countries could distort the results of the analysis.[3] Three countries where the USD is the legal tender (Ecuador, El Salvador and Panama) are also excluded from the analysis.

2.1 Trends in foreign currency and local currency denominated debt

Figure 1 shows the total and the mean and median shares of local currency and foreign currency denominated debt of the general government for 85 developing countries between January 2010 and May 2024.[4] The left panel of the figure shows that local currency denominated debt represents about 80 per cent of the total throughout the period considered. However, this result is influenced by a heavy concentration of debt among a few countries, with the top 4 debtors (Brazil, India, Mexico and Republic of Korea) accounting for 55 per cent of the total. The central panel shows simple means for each period of the share of local and foreign currency denominated debt for the 85 countries in the sample. In this case, the data shows an increase in the share of foreign currency denominated debt of 15 percentage points, from 25 per cent in January 2010 to 40 per cent in May 2024. The right panel shows a steeper increase in this share, from 2.5 per cent in January 2010 to 35 per cent in May 2024.

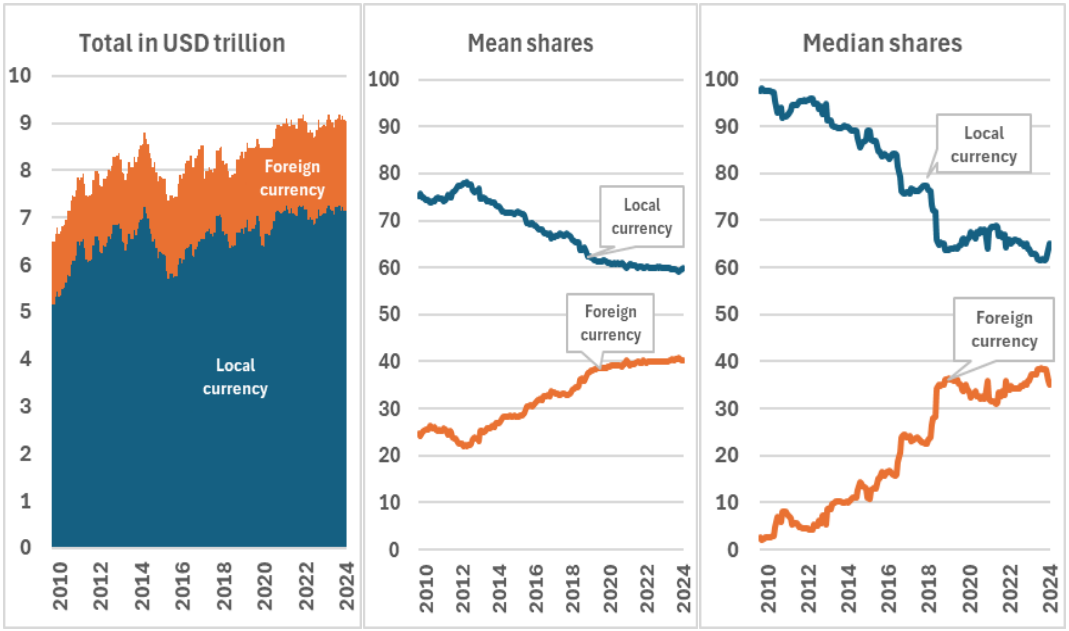
Overall, the data shown in Figure 1 suggests that the share of foreign currency denominated debt of large debtors did not change much or even

[3] Between January 2010 and May 2024, China represented 30 per cent of the general government debt of all the developing countries, on average, but the share increased from 11.5 per cent to 52.3 per cent between the two periods. Excluding China, Ecuador, El Salvador and Panama, 85 developing countries remain in the database. Their general government debt, excluding bills, is based on 59,464 sovereign and subnational bonds.

[4] For comparability across countries, the totals are in USD trillion, which required converting local currency denominated debt into USD using average monthly exchange rates published at the World Bank's Global Economic Monitor database. The computation of average and median shares of local currency and foreign currency denominated debt was performed using local currency values.

decreased during the period considered, while that of smaller debtors increased. To obtain more granular information, Figure 2 shows the median shares of local currency and foreign currency denominated debt of the general government of developing countries grouped according to the MSCI classification of securities market development (see Annex 1 for details).

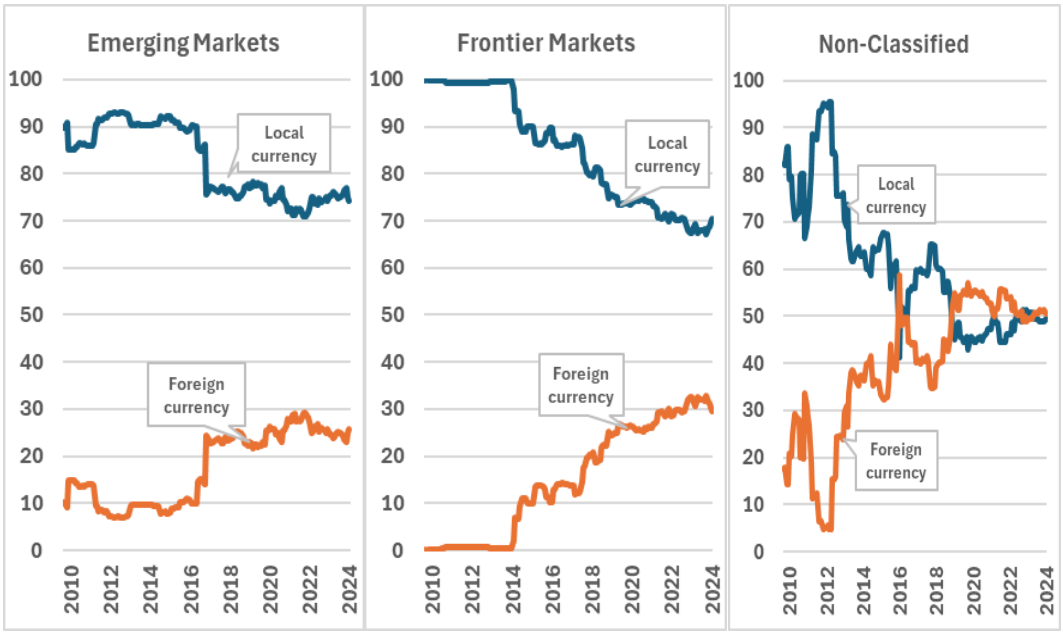
Figure 1 Totals, Mean Shares, and Median Shares of Local and Foreign Currency Denominated Bond Debt of the General Government of Developing Countries, January 2010 to May 2024



Data source: Datastream (downloaded in June 2024) and World Bank's Global Economic Monitor database (downloaded in March 2025).

The figure shows that the median share of foreign currency denominated debt increased for emerging markets, frontier markets and countries not classified by MSCI. For emerging markets, the median share of foreign currency denominated debt increased from around 10 per cent in the first half of the period to around 25 per cent in the second half. Until 2014 the median frontier market country had less than 1 per cent of its debt denominated in foreign currency, but this figure increased steadily during the rest of the period, reaching around 30 per cent by 2024. The time series of the median share of foreign currency denominated debt of countries not classified by MSCI is more volatile, but it shows a clear upward trend, from an average of 20 per cent during 2010-2013 to an average of over 50 per cent during 2020-2024.

Figure 2 Median Shares of Local Currency and Foreign Currency Denominated Debt of the General Government of Developing Countries, by Financial Market Development, January 2010 to May 2024



Data source: Datastream (downloaded in June 2024) and World Bank's Global Economic Monitor database (downloaded in March 2025).
Note: See Annex 1 for the composition of the country groupings.

In sum, the data shows an increase in the median share of foreign currency denominated debt regardless of the level of securities market development. The increase is more marked in frontier markets than in emerging markets, and the median share of foreign currency denominated debt achieved the highest values in the countries not classified by MSCI. These trends may be explained by various factors, including needs for additional financing in developing countries, availability of external sources of financing, and difficulties to raise enough financing in local currency, as postulated by the original sin hypothesis. The next section provides additional evidence of this hypothesis.

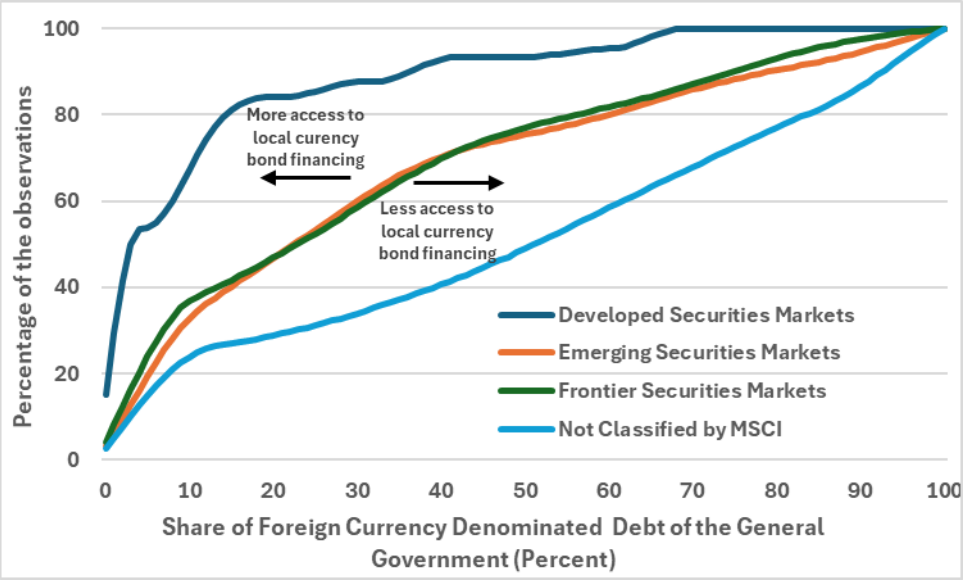
2.2 Evidence of the original sin hypothesis

As noted in the introduction, the original sin hypothesis refers to the inability of most developing countries to borrow in their own currencies abroad. An implication of the hypothesis is that smaller countries with less developed financial markets will tend to have less access to local currency denominated bond financing. As such, they will have a higher share of their

bond debt denominated in foreign currency, which makes them highly exposed to currency risk.

Figure 3 shows that this is indeed the case. It shows the cumulative distributions of the share of foreign currency denominated debt of the general government by countries grouped according to the level of development of their securities markets. The data set is the same one utilized in the previous section but a small sample of countries with developed securities markets is also included for comparison purposes. The cumulative distributions show in the y-axis the percentage of the observations of each group of countries for which the share of foreign currency denominated debt is equal or less than a specific value in the x-axis. For example, the share of foreign currency denominated debt is equal to or less than 20 per cent in 84 per cent of the observations of countries with developed securities markets, in 47 per cent of the observations of emerging and frontier market countries, and in 29 per cent of the observations of countries not classified by MSCI.

Figure 3 Cumulative Distribution of the Share of Foreign Currency Denominated Bond Debt, by Securities Market Development



Data source: Datastream (downloaded in June 2024) and World Bank's Global Economic Monitor database (downloaded in March 2025).
Note: See Annex 1 for the composition of the country groupings.

The distributions of observations for emerging and frontier market countries are very similar and in between the distribution for countries with

developed securities markets and countries not classified by MSCI. Clearly, the countries with advanced securities markets have more access to debt financing in local currency, while the countries not classified by MSCI, which presumably have the lowest levels of securities market development, have the least access to debt financing in local currency. Emerging and frontier market countries are in between these two extremes.

In sum, the level of development of securities markets seems to be positively correlated to the level of access to local currency bond financing. Developing countries need a lot of financing to advance their process of development, but their low level of securities market development reduces their access to local currency financing, implying that they need to rely more on foreign currency financing. As we discuss in the next section, such financing is subject to considerable risk.

2.3 The local currency cost of foreign currency denominated bond debt

According to Kapoor et al. (2021), unhedged currency risk poses one of the biggest threats to the finances of developing countries because currency depreciations increase the cost of foreign currency denominated debt and could even make it unserviceable, triggering debt distress. Such risk is partly a consequence of the original sin, given the unwillingness of international investors to lend to developing countries in their local currency, but it is also due to the limited financing in local currency available in their financial markets and the prevalent practice of international financial institutions, multilateral development banks and development finance institutions of lending in hard currencies, mostly USD. In addition, foreign currency denominated loans have lower interest rates than local currency loans. As such, they are often tempting for politicians, corporates and decision makers who have a short-term horizon, even when such loans may be substantially more expensive in the long term (Kappor et al., 2021).

To investigate the cost of bond debt denominated in foreign currency, we examine the impact of currency depreciation on both the principal and coupon payments using a sample of 832 foreign currency denominated bonds issued by 54 developing countries for which we can observe their

whole life between issue date and maturity.[5] The 832 foreign currency denominated bonds considered have an aggregate face value of USD 600.7 billion.

For each bond we compute the additional cost due to currency depreciation on both the repayment of the principal and on coupon payments. Both costs are expressed as annual average percentages, for comparability with the coupon rate. The computation depends on the type of bond. As noted above, for plain vanilla fixed coupon bonds, discount bonds, and zero-coupon bonds the principal due to bondholders at maturity is equal to the face value of the bond. In this case, the annualized additional cost of repayment of the bond due to currency depreciation, $AddCostPrin_{bc}$, is equal to the average rate of depreciation between the date of issue and the maturity of the bond:

$$(2)\ AddCostPrin_{bc} = 100 \times \left\{ \left[\frac{\left(\frac{LCU_c}{CD_b}\right)_{t_m^b} \times (Face\ Value)_{bc}}{\left(\frac{LCU_c}{CD_b}\right)_{t_0^b} \times (Face\ Value)_{bc}} \right]^{\frac{1}{Tenor_{bc}}} - 1 \right\} = \left(\frac{\Delta E_c}{E_c}\right)_{bc},$$

where $(Face\ Value)_{bc}$ and $Tenor_{bc}$ are, respectively, the face value and the tenor of bond b issued by country c, $\left(\frac{LCU_c}{CD_b}\right)$ is the exchange rate expressed as local currency units of country c per unit of the currency of denomination of bond b, and $\left(\frac{\Delta E_c}{E_c}\right)_{bc}$ is the average annual depreciation of the local currency of country c vis-a-vis the currency of denomination of the bond between the time of issuance t_0^{bc} and the time of maturity t_m^{bc}. The annual additional cost of coupon payments can be computed as

$$(3)\ AddCostCoupon_{bc} = Coupon_{bc} \times \left[\frac{\left(\frac{\Delta E_c}{E_c}\right)_{bc}}{100} \right].$$

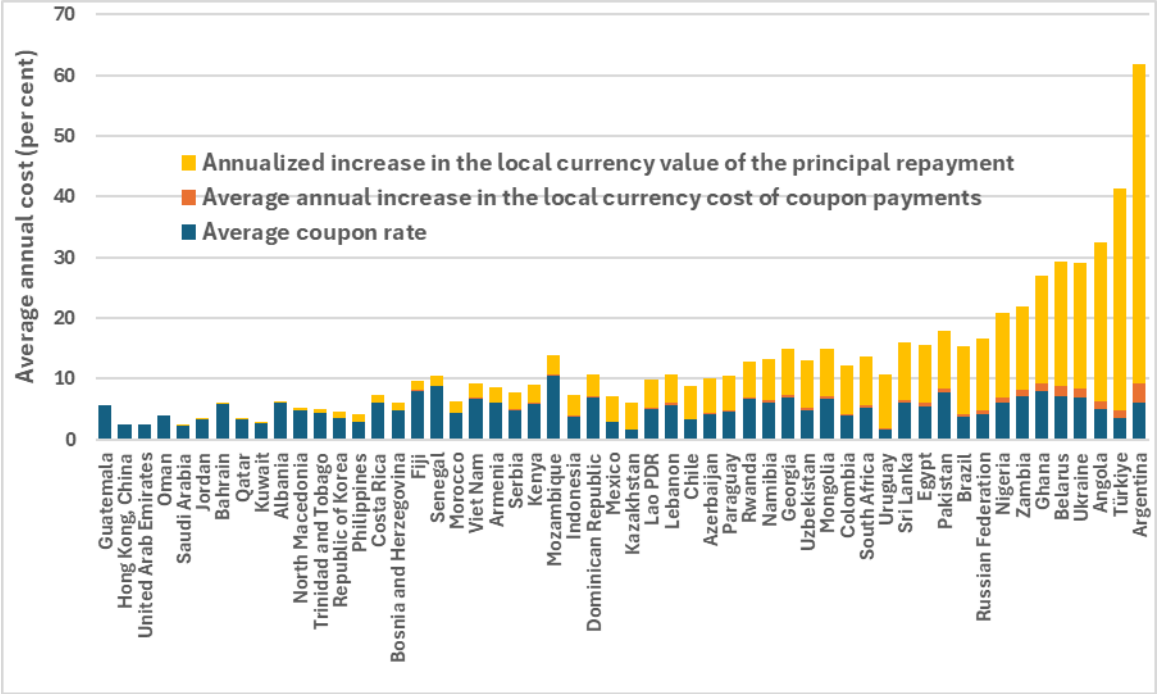
Given the above, the total annualized cost of foreign currency denominated bonds in local currency for plain vanilla fixed coupon bonds, discount bonds, and zero-coupon bonds is

[5] An initial selection of bonds included only one pay at maturity fixed bond. For simplicity this bond was excluded. The remaining 832 bonds in the sample include 817 plain vanilla fixed coupon bonds, 15 discount bonds, and 1 zero-coupon bond.

(4) $TotalCostLC_{bc} = Coupon_{bc} + \left(\frac{\Delta E_c}{E_c}\right)_{bc} \times \left[1 + \frac{Coupon_{bc}}{100}\right]$.

After computing the three components of the total cost in local currency for each bond, we aggregated them for each country as weighted averages using the face value of each bond in USD at the time of issue as weights. The weighted averages for the 54 countries are shown in Figure 4.

Figure 4 Average Annual Local Currency Cost of Sovereign Bonds Issued in Foreign Currency by Developing Countries, January 2010 – May 2024



Data source: Datastream (downloaded in June 2024) and World Bank's Global Economic Monitor database (downloaded in March 2025).
Notes: Weighted averages per country using the shares of the face value in USD of each bond at the time of issuance as weights.

As the figure shows, there is substantial heterogeneity in the average annual local currency cost of foreign currency denominated bonds. For countries with low rates of currency depreciation, there is little additional cost, but for countries with high rates of currency depreciation, the additional cost – and hence the risk of foreign currency financing – can be huge. To make this point clear, we classify the 54 developing countries in the figure into three groups of 18 countries according to the average annual increase in the local currency value of their foreign denominated sovereign bonds.

The low-cost group ranges from Guatemala to Senegal on the left of the chart. The countries in this group had an average coupon rate of 4.52 per cent. With the average annual depreciation of the local currency vis-a-vis the USD adding an additional local currency cost of 0.54 per cent, the total cost of foreign currency denominated bonds for the group was 5.06 per cent, slightly higher than the coupon rate. The medium-cost group ranges from Morocco to Georgia, in the center of the chart. For this group of countries, the average coupon rate was 5.31 per cent, but with the average annual depreciation of the local currency vis-a-vis the USD added 4.53 per cent, almost doubling the coupon rate to a total cost of foreign currency denominated bonds of 9.84 per cent. The high-cost group ranges from Uzbekistan to Argentina on the right of the chart. Although the average coupon rate of the foreign currency denominated bonds of this group was a reasonable 5.51 per cent, the average annual depreciation of the local currency vis-a-vis the USD added 17.23 percentage points, increasing the total cost of foreign currency denominated bonds to 22.74 per cent, four times higher than the coupon rate.

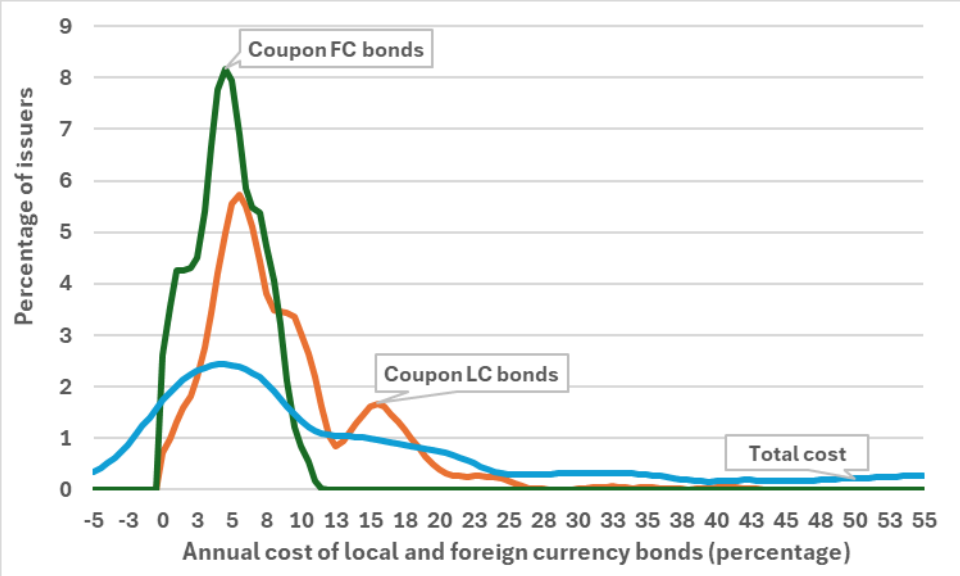
Given the potentially very high ex-post cost of foreign currency denominated sovereign bonds, a question that emerges is what the advantage of issuing these bonds is. To explore it, we first compare the coupon rates, tenors and face values of sovereign bonds issued in local and foreign currency by the same countries examined above. Lao PDR and United Arab Emirates were not included in the comparison because they did not issue local currency bonds in the period considered. The remaining 52 countries issued 6,721 local currency bonds comparable to the foreign currency bonds analyzed above.

The terms of the foreign currency denominated bonds in the samples are more favorable than those of the local currency denominated bonds, with lower median coupon rates (5 per cent compared to 7.1 per cent), longer median tenors (7.1 years compared to 4.4 years), and larger median face values ($666 million compared to $217 million). However, when including the annual increase in the local currency value of the foreign currency bonds, their median cost is 10 per cent.

For a more precise comparison, we consider a smaller matched sample of 648 local currency bonds and 341 foreign currency bonds issued by 36

developing countries. The bonds selected, both in local and foreign currency, were issued by the same country in the same year and with the same tenor. Figure 5 shows kernel densities based on this sample of coupon rates of bonds in both local and foreign currency, and the total annual cost of foreign currency bonds, which includes the increase in the value of coupon payments and principal due to depreciation of the local currency between the dates of issue and maturity.

Figure 5 Kernel Density Estimates of Coupon Rates of Local and Foreign Currency Bonds, and the Total Cost of Foreign Currency Bonds



Data source: Datastream (downloaded in June 2024) and World Bank's Global Economic Monitor database (downloaded in March 2025).
Notes: Estimates based on a matched sample of 648 local currency bonds and 341 foreign currency bonds issued by 36 developing countries. The bonds were matched by country of issue, year of issue and tenor. The three densities were estimated at intervals of 0.5 percentage points within the support of each distribution using Stata's command kdensity with the Epanechnikov kernel function.

The figure shows that while the distribution of coupon rates of foreign currency bonds is relatively symmetric with over 99 per cent of the bonds having values between 0 and 10 per cent, the distribution of local currency bonds is skewed to the right, with almost 30 per cent of the bonds having coupon rates exceeding 10 per cent. The distribution of the total annual cost of foreign currency bonds has a very large variance, with many bonds exhibiting extremely high values. For instance, 19 per cent of the foreign

currency bonds have an annual total cost exceeding 30 per cent, while 11 per cent have a negative annual total cost.

2.4 The local currency cost of public and publicly guaranteed external debt

The risk of borrowing in foreign currency goes beyond sovereign bonds. Official loans from multilateral development banks and development finance institutions are normally denominated in foreign currency and entail currency risk. For a broader perspective, the analysis is extended to a dataset of 109 developing countries from World Bank's International Debt Statistics (IDS). This database includes only low- and middle-income countries.

The source of the IDS database consists of annual reports to the World Bank by its members through the World Bank's Debtor Reporting System. In contrast to the bond data utilized in the analysis above, the IDS database aggregates data of individual loans or borrowing instruments by borrowing country and creditor. In IDS, the values of stock variables, such as debt, are expressed in US dollars using the exchange rate at the end of the year, while the values of flow variables, such as interest payments, are expressed in US dollars using the annual average exchange rate for the year (World Bank, 2024).

The concept of debt considered for the analysis using IDS data is external public and publicly guaranteed (PPG) debt. PPG debt is broader than sovereign debt from the general government because it includes debt by the central bank and other public agencies, as well as debt of private entities guaranteed by the government. Similarly to the previous analysis, loans of less than one year are not included in the analysis. External PPG debt is, however, narrower in that it excludes domestic debt.[6]

The IDS database includes information about the shares of PPG debt denominated in US dollars, euros, Japanese yens, Swiss francs, British pounds and special drawing rights, which on average represent 82.5 per

[6] According to the IMF (2014, p.5), gross external debt is defined as "outstanding amount of … actual current, and not contingent, liabilities that require payment(s) of principal and/or interest by the debtor at some point(s) in the future and that are owed to non-residents by residents of an economy."

cent of the observations of the sample used in this paper. The database includes two indicators on the currency composition of PPG debt – "all other currencies" and "multiple currencies" – which might include local currency, but that information is not publicly available. The working assumption is that 100 per cent of the PPG debt is denominated in foreign currency.

IDS includes the average interest rate in US dollars on new external debt commitments only. Nonetheless, it is possible to estimate the average interest rate of country c as of year t as

(5) $Int_{ct} = \frac{(Int\ Pay)_{ct}}{Debt_{c,t-1}}$,

where $(Int\ Pay)_{ct}$ and $Debt_{c,t-1}$ are, respectively, the interest payments during year t and the external debt stock at the end of year $t-1$ of country c, both expressed in US dollars. We can then compute the additional interest cost due to depreciation of the local currency expressed as a percentage of the external debt stock at the end of the previous period as

(6) $(Add\ Int\ Cost)_{ct} = \frac{(Int\ Pay)_{ct} \times (Ave\ E)_{ct}}{Debt_{c,t-1} \times (Eoy\ E)_{c,t-1}} - \frac{(Int\ Pay)_{ct}}{Debt_{c,t-1}} = (Int)_{ct} \times \left[\frac{(Ave\ E)_{ct} - (Eoy\ E)_{c,t-1}}{(Eoy\ E)c,_{t-1}}\right]$,

where $(Ave\ E)_{ct}$ and $(Eoy\ E)_{c,t-1}$ are, respectively, the average LCU/USD exchange rate of country c during year t and the LCU/USD exchange rate of country c at the end of year $t-1$. Finally, the additional local currency cost of the external debt of country c during year t can be computed as

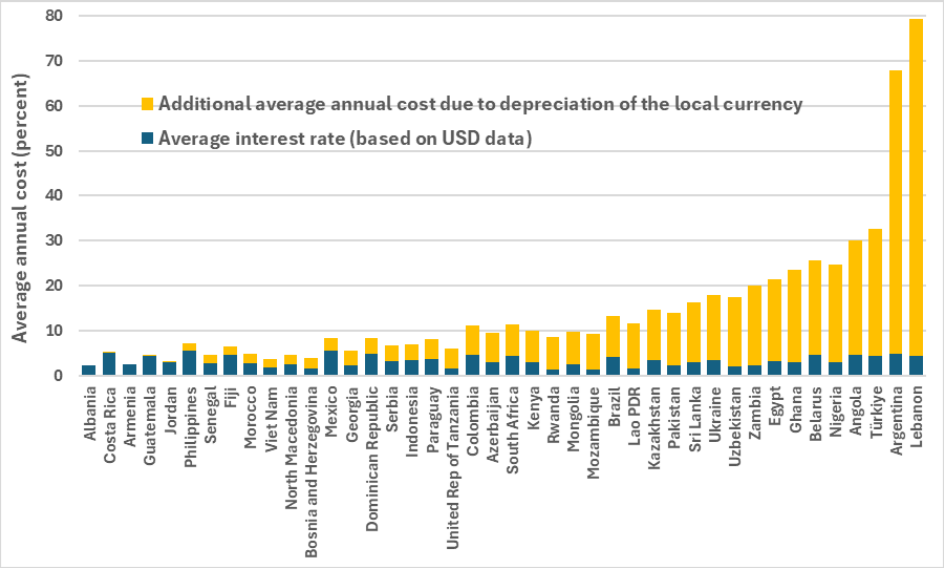
(7) $(Add\ Value\ of\ Debt\ in\ LC)_{ct} = 100 \times \left[\frac{(Eoy\ E)_{ct} \times (Debt)_{ct,t-1}}{(Eoy\ E)_{c,t-1} \times (Debt)_{c,t-1}} - 1\right] = \left(\frac{\Delta E}{E}\right)_{ct}$,

where $\left(\frac{\Delta E}{E}\right)_{ct}$ is year-on-year rate of depreciation of the local currency of country c vis-a-vis the US dollar between December of year $t-1$ and December of year t.

Given the large number of countries in the IDS database, the calculations are shown in Figure 6 for a sample of 42 developing countries from the IDS database that are also included in Figure 4. The outstanding external debt of these countries at the end of 2023 was $2.2 trillion, 57 per cent of

which was owed to official creditors. In the chart, the additional average annual cost due to depreciation of the local currency includes the sum of $(Add\ Int\ Cost)_{ct}$ and $(Add\ Value\ of\ Debt\ in\ LC)_{ct}$. Each observation in the figure is a weighted average of the 14 annual observations between 2010 and 2023. The weights are the stocks of PPG debt at the end of each year.

Figure 6 Average Annual Local Currency Cost of External PPG Debt, 2010 – 2023



Data sources: World Bank's International Debt Statistics and Global Economic Monitor databases (downloaded in March 2025).
Notes: Weighted averages of annual observations per country using the stock of external debt as weights. The average interest rate includes the effect of depreciation on the local currency value of interest payments

Given the mix of official and private creditors in the IDS database, the median interest rate for the 42 countries in the figure is 3.5 per cent, compared to an average coupon rate of 5.7 per cent for the same countries in the bonds database. However, the additional average annual cost due to depreciation of the local currency has a median of 6. per cent and the median of the total annual cost of external debt in local currency is 9.4 per cent, almost three times the interest rate.

Overall, the ranking of countries according to the annual average depreciation of the exchange rate is similar in Figures 4 and 6, with a rank correlation coefficient of 0.88. A notable exception is Lebanon, which, due to an unprecedented economic and financial crisis since 2018, abandoned

a fixed exchange rate of 1,507 LBP per USD that was in place since December 1997 with a mega devaluation of 890 per cent in February 2023. As a result, the annual average depreciation of the LBP over the period 2010-2023 was 75 per cent, even though it was close to zero between 2010 and 2022.[7]

The general conclusion from this analysis is that the risks posed by foreign currency denominated public debt to developing countries are similar whether the creditors are private bondholders or official creditors. The average annual cost of currency depreciation is twice as high as the interest rate in around half of the developing countries in both samples, and significantly higher for some of them. It should be pointed out, however, that an increase in the local currency value of the principal of a foreign currency denominated bond does not necessarily increase debt servicing costs because a new bond could be issued to refinance the maturing bond. Nonetheless, the book value of the new bond expressed in local currency could be higher, and even substantially higher, than that of the old bond.

In general, if a country experiences a high rate of currency depreciation, its treasury or debt management office will need to refinance increasingly larger amounts of debt expressed in local currency, even if there is not much change in the foreign currency amount. Such increasing refinancing needs can be not only complicated but also increase the risk of debt distress. But will currency depreciation reduce fiscal space? This is examined in the next section.

3. Fiscal implications

This section considers the impact of increased debt servicing costs, part of which could be related to exchange rate depreciation, on fiscal space. The analysis is based on a simple indicator of fiscal space proposed by Isgut (2025a):

[7] As noted above, the average annual depreciation of the exchange rate of the countries in Figure 4 was calculated as a weighted average of the average annual depreciations of each bond issued at or after January 2010 and with maturity at or before December 2024. Lebanon issued 25 foreign currency denominated sovereign bonds during that period but only two, with a combined weight of 8.4 per cent of the face value of the 25 bonds, matured after the February 2023 devaluation.

(8) $FSI_{it} = 1 - \frac{NIP_{it}}{(EH_{it}+EE_{it})}$,

where NIP_{it} is net interest payments of the general government, EH_{it} is public expenditure on health, EE_{it} is public expenditure on education, and i and t represent, respectively, the country and the year. The indicator is motivated by the analysis in the *World of Debt* report of the United Nations, which compared net interest payments of the general government to public expenditures in health and education (United Nations, 2023). Although the indicator differs from more traditional measures of fiscal space, which are often based on the difference between a sustainable level of the debt-to-GDP ratio d^* and the current debt-to-GDP ratio d (Cheng and Pitterle, 2018), it has two important advantages.

First, the net interest payments variable in the indicator captures both the level of debt and the interest rate on debt. Accounting for the impact of interest rates, in addition to the stock of debt, on fiscal space is important because countries of different levels of financial development and policy direction differ, often significantly, in their access to financial markets, inflation and monetary policies, all of which affect the interest rate and, hence, the cost of servicing government debt. Second, the notion that a developing country spends more on interest payments than on important categories of government expenditure, such as health and education, conveys the concept of having a low fiscal space in a manner that is intuitive and easy to communicate to the general public.

To be sure, the comparison of net interest payments with health and education expenditures may be considered arbitrary. Why not include other important categories of government expenditure such as infrastructure investment? Or expenses in climate change mitigation and adaptation? Or why not consider the ratio of net interest payments to all government expenditures? These questions are legitimate and deserve further scrutiny. In the meantime, and for the purposes of this paper, the proposed measure is considered an acceptable approximation to the concept of fiscal space.

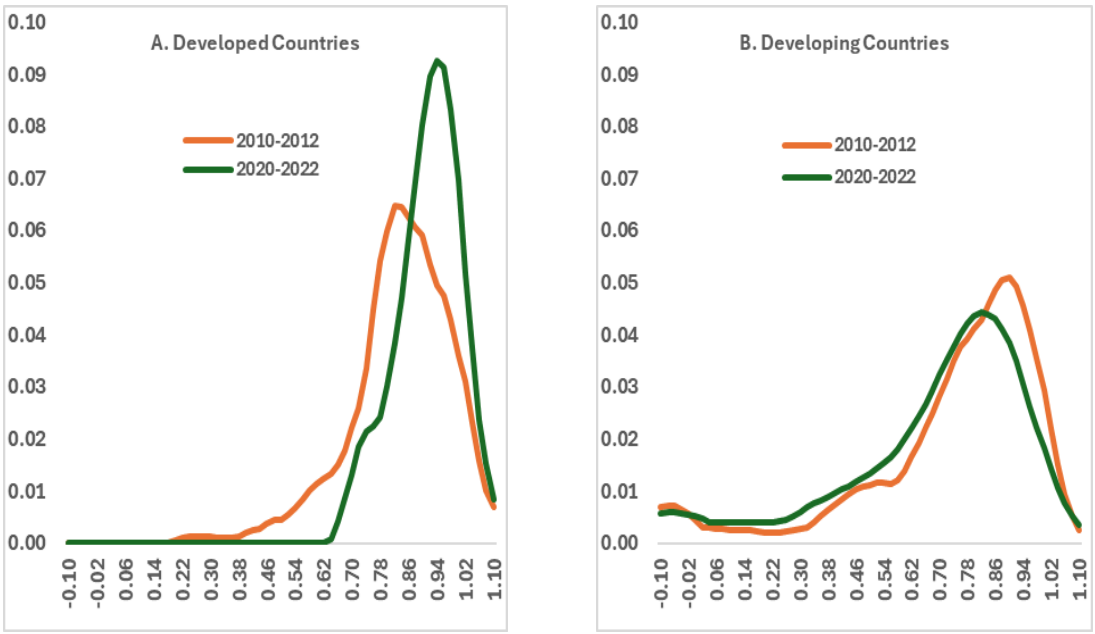
The FSI_{it} indicator can take values greater than 1 in countries where NIP_{it} is negative, that is in countries where the general government's interest income on its financial assets exceeds interest payments on its financial liabilities. These cases are relatively rare in the data for the period 2010-

2022, representing only 4.5 per cent of the observations. Most countries with negative values of NIP_{it} are developed countries such as Estonia, Luxembourg and Norway, but a few developing countries such as Kazakhstan, Republic of Korea and Uzbekistan have negative values of NIP_{it} in some years. On the other side of the distribution, only in some developing countries FSI_{it} takes negative values, meaning that net interest payments exceed the sum of public expenses in health and education. This situation occurs in only 4 per cent of the observations. Countries with more frequent episodes of negative FSI_{ct} include Ghana, Lebanon, Nigeria, Pakistan, and Sri Lanka.

Interestingly, the indicator moved in different directions in developing and developed countries over the last decade or so. Figure 12 shows kernel density estimates of the distribution of FSI_{it} in developed and developing countries for the periods 2010-2012 and 2020-2022 and shows that while the distribution in the developed countries shifted to the right, indicating an improvement in fiscal space, the distribution shifted to the left in developing countries, indicating a worsening in fiscal space.

For the developed countries, the median of the distribution increased from 0.84 in 2010-2012 to 0.93 in 2020-2022. This means that for the median developed country, the ratio of net interest payments to public expenditures in health and education dropped from 16 per cent in 2010-2012 to 7 per cent in 2020-2022. In contrast, in developing countries the median of the distribution dropped from 0.81 in 2010-2012 to 0.76 in 2020-2022, meaning that net interest payments increased from 19 per cent to 24 per cent of public spending in health and education. The worsening of the distribution for developing countries was more pronounced in the lower quantiles. For instance, the first quartile dropped from 0.66 to 0.57, meaning that the ratio of net interest payments to public expenses in health and education increased from 34 per cent in 2010-2012 to 43 per cent in 2020-2022.

Figure 7 Estimated Density Functions of the Fiscal Space Indicator, by Development Status, 2010-2012 and 2020-2022



Source: Author, based on data from the April 2025 IMF's World Economic Outlook database and the World Bank's World Development Indicators database (accessed in July 2025).

To explain changes in FSI_{ct}, likely candidate variables could include the debt-to-GDP ratio, the interest rate on the public debt, and the revenue-to-GDP ratio. Given the results of the previous section, we will also consider exchange rate depreciation. The first two variables are expected to be negatively correlated with the indicator because higher levels of public debt and interest rates on the public debt will increase interest payments on the public debt, which will increase NIP_{it} and decrease FSI_{it}. The revenue-to-GDP ratio may allow for increases in public expenditures on health and education, $(EH_{it} + EE_{it})$, thus increasing FSI_{it}. Finally, it is possible that FSI_{it} is negatively correlated with exchange rate depreciation due to increases in the local currency cost of servicing foreign currency denominated public debt, which would cause NIP_{it} to increase.

The data used in the regression analysis covers the period 2011-2022 and is summarized in Table 1. The regressions are estimated using two datasets, one including all the countries available in the IMF's World Economic Outlook database (166 countries), and a sub-dataset including only low- and middle-income countries included in the World Bank's International Debt Statistics database (114 countries). The dependent variable is the FSI

indicator expressed as percentage. The explanatory variables are the debt-to-GDP ratio, the revenue-to-GDP ratio, the depreciation of the exchange rate, calculated as the year-on-year change in the local currency units per US dollar exchange rate, and two proxy indicators for the interest rate on public debt. The explanatory variables are lagged to reduce the possibility of reverse causality.

Table 1 Data Summary

	All countries (166 Countries, 1761 Obs.)			Low- and Middle-Income Countries (114 Countries, 1140 Obs.)		
Variable	**Median**	**10th Percentile**	**90th Percentile**	**Median**	**10th Percentile**	**90th Percentile**
FSI	80.9	40.8	97.5	77.9	29.2	94.3
Lagged Debt-to-GDP	46.1	21.1	96.9	42.9	21.0	80.8
Lagged Revenue-to-GDP	25.9	13.8	44.9	21.8	12.8	36.4
Lagged Net Interest Rate	2.9	0.7	6.5	3.1	1.1	6.9
Lagged Exchange Rate Depreciation	0.8	-4.2	14.9	2.1	-3.3	16.7
Lagged Share of Bonds in PPG External Debt	..	..	..	4.6	0.0	57.4

Source: Author based on data from the April 2025 IMF's World Economic Outlook database and the World Bank's World Development Indicators database (accessed in July 2025).

Note: The datasets, which cover the period 2011-2022, are unbalanced panels due to missing observations of the dependent variable. On average, the datasets with all countries and low- and middle-income countries include, respectively, 10.6 and 10 observations per country out of a maximum of 12 observations per country.

To prepare the data for estimation selected observations were replaced by cutoff floors or ceilings, or winsorized in statistical parlance. The selection of these cutoffs was done through visual inspection of the data and with the aim of minimizing the number of winsorized observations. See Annex 2 for details. In each of the two samples, the regression was estimated using ordinary least squares (OLS), robust regression, fixed effects (FE) and between estimation methods. The OLS and robust regressions included dummy variables for the level of development of the country's securities market and year dummy variables. The results are shown in Tables 2 and 3.

Table 2 Regression Results for All Countries

Explanatory Variable	166 Countries, 1761 Observations			
	(1)	(2)	(3)	(4)
Lagged Debt-to-GDP	-0.333***	-0.236***	-0.445***	-0.282***
	(0.016)	(0.008)	(0.018)	(0.049)
Lagged Revenue-to-GDP	0.529***	0.241***	0.668***	0.492***
	(0.042)	(0.020)	(0.081)	(0.120)
Lagged Net Interest Rate	-6.612***	-4.258***	-4.399***	-7.598***
	(0.220)	(0.103)	(0.273)	(0.666)
Lagged Exchange Rate Depreciation	-0.302***	-0.044*	-0.142***	-0.247
	(0.051)	(0.024)	(0.028)	(0.277)
Developed Securities Market	3.480**	5.717***	..	..
	(1.559)	(0.733)		
Emerging Securities Market	0.137	0.847	..	..
	(1.380)	(0.648)		
Frontier Securities Market	-9.836***	-0.939*	..	..
	(1.204)	(0.566)		
Constant	100.5***	98.18***	92.45***	98.91***
	(2.258)	(1.061)	(2.802)	(5.016)
R-Square	0.607	0.727	0.403	0.645
Estimation Method	OLS	Robust	FE	BE
Year Dummies	Yes	Yes	..	..

Source: Author based on data from the April 2025 IMF's World Economic Outlook database and the World Bank's World Development Indicators database (accessed in July 2025).
Note: The data covers the period 2011-2022. *** p-value<.001, ** p-value<.001, * p-value<.05.

In both datasets, the explanatory power of the model is quite strong, with high values of the R-Square coefficient. Similarly, in both datasets the impact on fiscal space of the lagged debt-to-GDP ratio, the lagged revenue-to-GDP ratio, and the lagged net interest rate is robust across models and statistically significant at the 0.1 per cent level. In addition, the lagged value of exchange rate depreciation has a negative impact on fiscal space. Interestingly, the estimated coefficient of this variable is not statistically significant in the between (BE) estimations, which capture cross-sectional but not time-series variation in the data. This suggests that the impact of exchange rate depreciation on fiscal space mostly reflects variation over time within the same countries.

The estimations for the lagged share of bonds in PPG external debt in the sub-dataset of low- and middle-income countries show contradictory results, with a positive and statistically significant estimated coefficient in the OLS regression and a negative and statistically significant estimated coefficient in the FE regression. The reason could be the presence of an omitted variable positively correlated with both the dependent variable, the fiscal space indicator, and the share of bonds in PPG debt. The omitted variable could be the country's credit rating because a country's fiscal position is an important consideration of credit rating agencies and countries with better ratings have more access to bond markets and in better terms. The FE regression controls for unobserved country variables that do not vary over time, which may include the country's credit rating, which in many cases is stable over time. Although the securities market dummies control to some extent for credit ratings, they do not account for cross-country variation within each category of market development.

The impact on FSI of a change in the explanatory variables, denoted by the vector Δx, is calculated as

(1) $\Delta\widehat{FSI} = \hat{\beta}_x \Delta x,$

where $\hat{\beta}_x$ is a vector of coefficient estimates. Considering the dissimilar trajectories of FSI in developed and developing countries shown in Figure 7, an interesting exercise is to compute $\Delta\widehat{FSI}$ separately for developed and developing countries using the regression results in Table 2. For that purpose, Δx was calculated separately for developed and developing countries as the differences between the median values of the explanatory variables x between 2010-2012 and 2020-2022. In this calculation, only the main variables (debt-to-GDP, revenue-to-GDP, net interest rate, and exchange rate depreciation) are included. The exercise was conducted with the four sets of coefficient estimates reported in Table 2, and the results were similar across them. Table 4 shows the results using the estimated coefficients from the OLS regression (Column 1 of Table 2).

Table 3 Regression Results for the Low- and Medium-Income Countries

Explanatory Variable	114 Countries, 1140 Observations			
	(1)	(2)	(3)	(4)
Lagged Debt-to-GDP	-0.457*** (0.025)	-0.305*** (0.013)	-0.434*** (0.025)	-0.436*** (0.077)
Lagged Revenue-to-GDP	0.745*** (0.067)	0.367*** (0.033)	0.597*** (0.102)	0.615*** (0.177)
Lagged Net Interest Rate	-8.125*** (0.288)	-5.101*** (0.143)	-4.536*** (0.361)	-9.139*** (0.891)
Lagged Exchange Rate Depreciation	-0.351*** (0.058)	-0.093*** (0.029)	-0.165*** (0.036)	-0.052 (0.276)
Lagged Share of Bonds in PPG External Debt	0.077** (0.032)	-0.023 (0.016)	-0.114*** (0.034)	0.163* (0.085)
Developed Securities Market	-6.602 (7.425)	-1.885 (3.694)	..	..
Emerging Securities Market	1.521 (2.292)	4.865*** (1.140)	..	..
Frontier Securities Market	-12.942*** (1.565)	-1.667** (0.779)	..	..
Constant	107.2*** (2.987)	100.2*** (1.486)	94.26*** (3.171)	104.7*** (6.412)
R-Square	0.654	0.741	0.400	0.684
Estimation Method	OLS	Robust	FE	BE
Year Dummies	Yes	Yes	..	..

Source: Author based on data from the April 2025 IMF's World Economic Outlook database and the World Bank's World Development Indicators database (accessed in July 2025).

Note: The data covers the period 2011-2022. *** p-value<.001, ** p-value<.001, * p-value<.05.

Table 4 Predicted Impact on *FSI* of Changes in the Medians of the Explanatory Variables between 2010-2012 and 2020-2022

	FSI	Debt-to-GDP	Revenue-to-GDP	Net Interest Rate	Exchange Rate Depreciation	Predicted FSI
A. Developed Countries						
(1) Median 2010-2012	84.21	61.2	39.1	2.88	1.16	
(2) Median 2020-2022	92.70	65.0	41.4	1.60	-1.76	
(3) Difference (2) - (1)	8.50	3.83	2.26	-1.28	-2.92	
(4) Partial Effect		-1.3	1.2	8.5	0.9	9.27
(5) Share in Predicted FSI		-13.8	12.9	91.3	9.5	
B. Developing Countries						
(1) Median 2010-2012	80.80	34.8	22.1	3.38	0.69	
(2) Median 2020-2022	75.71	56.9	23.0	2.98	1.18	
(3) Difference (2) - (1)	-5.08	22.06	0.93	-0.41	0.49	
(4) Partial Effect		-7.3	0.5	2.7	-0.1	-4.32
(5) Share in Predicted FSI		170.1	-11.4	-62.1	3.4	
Memo Item						
OLS Estimated Coefficients		-0.333	0.529	-6.612	-0.302	

Source: Author based on data from the April 2025 IMF's World Economic Outlook database and the World Bank's World Development Indicators database (accessed in July 2025).
Note: The partial effects (Line 4) are calculated as Line 2 times the corresponding OLS estimated coefficient. The predicted FSI is the sum of the partial effects. Line (5) shows the share of each partial effect in predicted FSI data (in percentage).

The table shows, first, that the OLS estimates do a good job in predicting the change in *FSI* between 2010-2012 and 2020-2022 for both developed and developing countries. The data in the table confirms the results in Figure 7 that between these two periods there was an improvement in fiscal space in developed countries and a deterioration in developing countries. The table adds information about the reasons for these disparate trends. In the case of the developed countries, the main reason is the decrease in net interest rates, which account for over 90 per cent of the predicted change in *FSI*. In developing countries, in contrast, the main reason is the large increase in the debt-to-GDP ratio, which accounts for 170 per cent of the predicted change in *FSI*. In this group of countries, the net interest rate also decreased between 2010-2012 and 2020-2022 but much less than in the developed countries. This decrease, nonetheless, compensated partially for the adverse impact of the debt-to-GDP ratio.

To conclude the analysis of this section, the impact of exchange rate depreciation on fiscal space is examined a little more. The regressions in Tables 2 and 3 capture the impact of this variable on fiscal space above and beyond any indirect impact it may have on other variables, such as debt-to-GDP or the net interest rate on government debt. This impact was found to be negative and statistically significant in most of the regression models estimated, with the between regressions being an important exception. While this is an important finding, the transmission channel from exchange rate depreciation to fiscal space may also include indirect effects through other explanatory variables.

Given the definition of FSI_{it} in Equation (8), exchange rate depreciation could have a negative effect on FSI through either an increase in NIP_{it} or a decrease in $(EH_{it} + EE_{it})$. The former would be expected given the increase in the local currency value of principal and interest payments on foreign currency denominated debt discussed in the previous section. Because foreign currency denominated debts and interest payments are recommended by the IMF to be converted into domestic currency in the national public debt statistics (IMF, 2011), we would expect the effect of exchange rate depreciation on NIP_{it} to be partly captured by the debt-to-GDP and the net interest rate in the regressions in Table 2 and 3. The negative impact of exchange rate depreciation on $(EH_{it} + EE_{it})$ could occur because countries with large rates of depreciation of the exchange rate often have high inflation rates, which causes losses in fiscal revenues and may lead to fiscal deficits.[8] A decrease in $(EH_{it} + EE_{it})$ could be the result of an attempt to correct these deficits through budget cuts.

A proper analysis of causality is beyond the scope of this paper, but as a preliminary exploration Table 5 shows pairwise regressions of the main explanatory variables in Table 2 on lagged exchange rate depreciation. The regressions, which are run using fixed effects and between regressions, allow us to explore indirect channels of impact from exchange rate depreciation to FSI_{it} through the other explanatory variables.

[8] Due to a lag between accrual and payment of taxes, inflation in the interim period will decrease the real value of tax revenues. If the real value of government spending is maintained, the erosion of real tax revenue can generate an unintended fiscal deficit (Choudhry, 1990). This has been known as the Olivera-Tanzi effect.

Table 5 Pairwise Regressions on Lagged Exchange Rate Depreciation

	166 Countries, 1761 Observations	
Dependent Variable	**(1)**	**(2)**
Debt-to-GDP	0.164***	-0.732
	(0.037)	(0.445)
Revenue-to-GDP	-0.006	-0.492*
	(0.008)	(0.193)
Net Interest Rate	-0.001	0.081*
	(0.002)	(0.035)
Estimation Method	FE	BE

Source: Author based on data from the April 2025 IMF's World Economic Outlook database and the World Bank's World Development Indicators database (accessed in July 2025).
Note: The table shows estimated coefficients of six simple regressions of the main explanatory variables in Table 2 on lagged exchange rate depreciation. The data covers the period 2011-2022. *** p-value<.001, ** p-value<.001, * p-value<.05.

The results reveal some interesting differences between the fixed effects and between estimates. Among the fixed effects estimates, which capture within differences for each country, lagged exchange rate depreciation has a positive and statistically significant effect on the debt-to-GDP ratio. This means that years when the exchange rate depreciation is higher than average for countries are followed by years when the debt-to-GDP ratio is higher than average. In the fixed effects regressions, there is no impact of lagged exchange rate depreciation on revenue-to-GDP or the net interest rate.

In contrast, in the between regressions, which capture the effect of the average in each country of lagged exchange rate depreciation on the average of each dependent variable, the estimated coefficient is positive and statistically significant in the revenue-to-GDP regression and negative and statistically significant in the net interest rate regression. This means that countries that have higher average rates of currency depreciation during the estimation period tend to have lower revenue-to-GDP ratios and higher net interest rates.

The finding that the lagged exchange rate has a positive and statistically significant coefficient in the fixed effects regression of debt-to-GDP but not in the between regression mimics the results in Tables 2 and 3. In future

research, it would be interesting to understand why this is so. Is it just an accounting issue, as foreign currency denominated debt is converted into higher local currency values in the national debt accounts? Or is there something else? Similarly, the lower government revenues and higher net interest rates of countries with higher average rates of currency depreciation deserves some explanation. Is the negative effect on government revenues due to an attempt to correct increasing budget deficits, as discussed above? Is the positive effect on net interest rates related to low credit ratings, which consider high rates of currency depreciation as increasing the risk of debt default and could make the cost of borrowing higher? All these questions deserve further scrutiny.

4. Conclusion

Although foreign currency denominated debt instruments are risky because a depreciation of the domestic currency will increase the local currency cost of paying interest and repaying the principal, developing country governments commonly use such instruments to finance infrastructure investments and other public expenses. The risks of foreign currency denominated debt came to the fore during the debt crises of the 1980s and 1990s, which stimulated many countries to develop local currency bond markets. Such development, however, has been difficult, especially for smaller countries. In this context, the "original sin" hypothesis was proposed over 25 years ago to highlight a specific challenge for the development of local currency bond markets: the low level of interest of international investors to participate in them, possibly because of their small size and low level of liquidity. The hypothesis has been found to still be relevant for most developing countries today (Eichengreen et al., 2023).

Despite its risks, the paper found that the share of foreign currency denominated public debt increased for the median developing country between January 2010 and May 2024. This increase was more marked for smaller debtors and frontier market economies. The paper also found additional evidence of the original sin hypothesis by comparing the cumulative distribution of the share of foreign currency denominated debt in total debt in countries with different levels of development of their securities market according to the MSCI classification. Consistently with the hypothesis, the countries with developed securities markets rely much

less on foreign currency denominated debt than countries with emerging and frontier securities markets, while countries that are not classified by MSCI, presumably those with the least developed securities markets, rely the most on foreign currency denominated debt.

The paper also evaluated the cost in local currency of foreign currency denominated public debt in developing countries using both a sample of 832 foreign currency denominated bonds issued by 54 developing countries and data on public and publicly guaranteed external debt from the World Bank's International Debt Statistics database. The bond data shows that there is substantial heterogeneity in the average annual local currency cost of foreign currency denominated bonds. For countries with low rates of currency depreciation, there is little additional cost, but for countries with high rates of currency depreciation, the additional cost – and hence the risk of foreign currency financing – can be huge. The results from the analysis using the World Bank's International Debt Statistics data are similar.

The last section of the paper explored whether exchange rate depreciation has an adverse effect on fiscal space. This hypothesis is plausible given the potentially very high local currency cost of servicing foreign currency denominated debt found in the paper. In a series of regressions using a simple indicator of fiscal space as dependent variable and variables such as the debt-to-GDP ratio, the revenue-to-GDP ratio and the net interest rate, the lagged value of exchange rate depreciation was found to have a negative impact on fiscal space in most estimations. An exception is the between (BE) estimations, which capture cross-sectional but not time-series variation in the data. This suggests that the impact of exchange rate depreciation on fiscal space mostly reflects variation over time within the same countries.

The regression models do a good job in predicting the change in the fiscal space indicator between 2010-2012 and 2020-2022 for both developed and developing countries, a period where fiscal space improved in the former and worsened in the latter. The model suggests that the improvement in fiscal space in developed countries was overwhelmingly due to a reduction in interest rates in these countries, while an increase in the debt-to-GDP

ratio was the main explanation for the worsening fiscal space in developing countries.

The last part of the paper includes a preliminary exploration of the transmission channels between currency depreciation and fiscal space using pairwise regressions of debt-to-GDP, revenue-to-GDP, and net interest rate on lagged exchange rate depreciation. The regression results suggest that countries that experience a higher than average depreciation of the exchange rate in a particular year will have a higher than average debt-to-GDP ratio in the following year. They also show that countries with higher average depreciation of the exchange rate tend to have lower than average revenue-to-GDP ratios and higher than average net interest rates. These findings highlight additional transmission channels between exchange rate depreciation and fiscal space, in addition to multivariate regression results already discussed. Understanding the precise nature of these transmission channels will require additional research in future.

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Annex 1 Classification of Countries and Jurisdictions by Securities Market Development

The countries included in the analyses of the paper using bond data exclude countries in North America, Western Europe and the European Union; countries that issued less than 30 bonds between 1 January 2010 to 31 May 2024; and Venezuela. Two jurisdictions usually included in financial databases (Hong Kong, China and Taiwan, Province of China) are added. The total number of countries and jurisdictions is 93. The classification is based on the MSCI classification of securities markets, which considers views and practices of the international investment community on three criteria: economic development, market size and liquidity, and accessibility.[9]

I. Countries and Jurisdictions with Developed Securities Markets (6)

Australia; Hong Kong, China; Israel; Japan; New Zealand; Singapore.

II. Countries and Jurisdictions with Emerging Securities Markets (22)[10]

Argentina; Brazil; Chile; China; Colombia; Egypt; India; Indonesia; Kuwait; Malaysia; México; Perú; Philippines; Qatar; Republic of Korea; Russian Federation; Saudi Arabia; South Africa; Taiwan, Province of China; Thailand; Türkiye; United Arab Emirates.

III. Countries with Frontier Securities Markets (23)[11]

Bahrain, Bangladesh, Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Jordan, Kazakhstan, Kenya, Lebanon, Mali, Mauritius, Morocco, Niger,

[9] See MSCI (2023). MSCI Market Classification Framework.

[10] Argentina and Russian Federation were reclassified by MSCI from emerging markets to "standalone" due to a severe deterioration in market accessibility or size and liquidity in November 2021 and March 2022, respectively. Since these reclassifications happened towards the end of the period covered, implying that for most if it the two countries were classified as emerging markets by MSCI, they are kept in this category in the database.

[11] Lebanon and Nigeria were reclassified by MSCI from frontier markets to "standalone" in February 2021 and February 2024, respectively. Since these reclassifications happened towards the end of the period covered, implying that for most of it the two countries were classified as frontier markets by MSCI, they are kept in this category in the database.

Nigeria, Oman, Pakistan, Senegal, Serbia, Sri Lanka, Togo, Tunisia, Viet Nam.

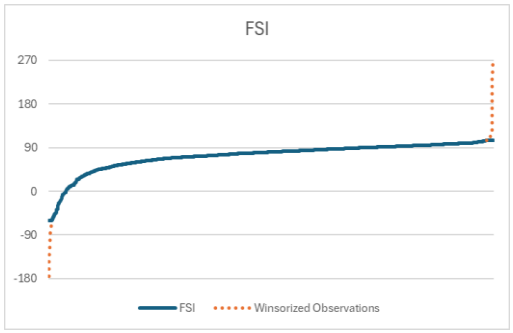
IV. Other Countries not Classified by MSCI (42)[12]

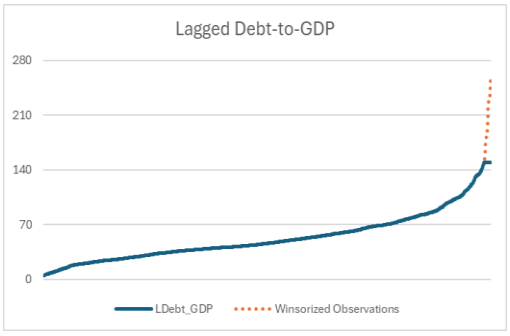
Albania, Algeria, Angola, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Botswana, Brunei Darussalam, Cameroon, Chad, Costa Rica, Dominican Republic, Ecuador, El Salvador, Eswatini, Fiji, Gabon, Georgia, Ghana, Guatemala, Lao People's Democratic Republic, Malawi, Mongolia, Mozambique, Myanmar, Namibia, North Macedonia, Panama, Papua New Guinea, Paraguay, Republic of Moldova, Republic of The Gambia, Rwanda, Seychelles, Trinidad and Tobago, Uganda, Ukraine, United Republic of Tanzania, Uruguay, Uzbekistan, Zambia.

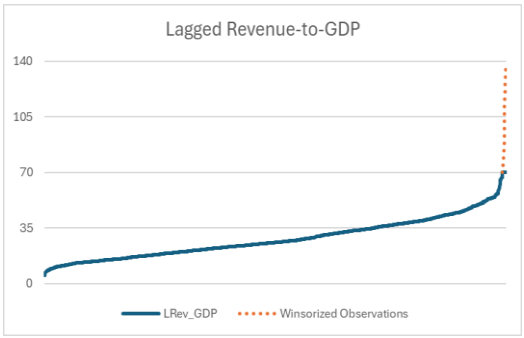
[12] Ukraine and Trinidad and Tobago were reclassified by MSCI from frontier markets to "standalone" in August 2015 and May 2011, respectively. Since these reclassifications happened towards the beginning of the period covered, the two countries are kept in the "other countries" category in the database.

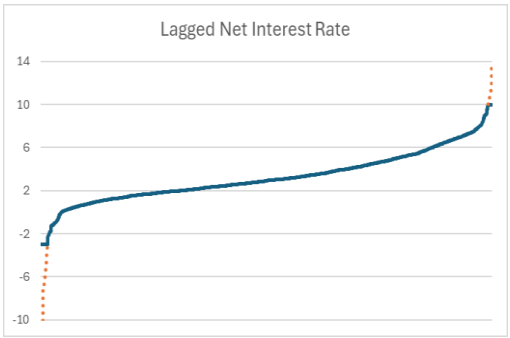
Annex 2 Treatment of Outliers in the Dataset for the Regression Analysis

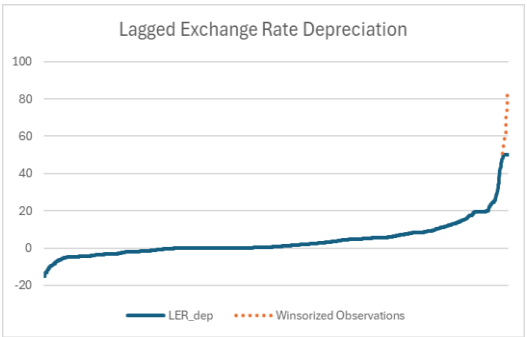
The distributions of the dependent variable and four of the explanatory variables had large outlier observations. To prevent them from having a large influence on the regression results, they were replaced by a cutoff ceiling or floor, or winsorized in statistical parlance. The selection of the ceilings and floors was based on a visual inspection of the data and with the aim of minimizing the number of winsorized observations. The figures below show the observations of the dependent and explanatory variables sorted from the lowest to the largest in solid blue lines. Winsorized observations are shown in dotted red lines in the charts. More information is provided below the charts.

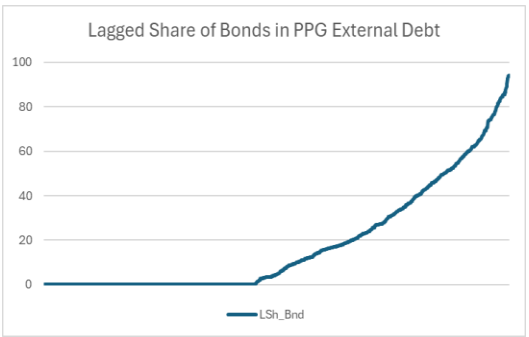












Information about winsorized variables

FSI: Floor cutoff -60, ceiling cutoff 105. 41 observations winsorized (2.33 per cent of the total). 12 observations with high negative values from Nigeria, Pakistan, Lebanon and Sri Lanka. 29 observations with positive values mostly from Kuwait, Norway, and Kazakhstan.

Lagged debt-to-GDP ratio: Ceiling cutoff +150. 26 winsorized observations mainly from Greece and Japan (1.48 per cent of the total).

Lagged revenue-to-GDP ratio: ceiling cutoff +70. 13 winsorized observations, mostly from Federated States of Micronesia and Kiribati (0.74 per cent of the total).

Lagged net interest rate: floor cutoff -3, ceiling cutoff +10. 40 observations winsorized (2.27 per cent of the total). 26 observations with high negative values mostly from Kuwait, Norway, and Kazakhstan. 14 observations with large positive values mostly from Ghana, Brazil and Trinidad and Tobago.

Lagged exchange rate depreciation: floor cutoff -15, ceiling cutoff +50. 24 winsorized observations (1.36 per cent of the observations). 2 observations with large negative values from Mozambique and Zimbabwe. 22 observations with large positive values from many countries including Angola, Argentina, Belarus, Mozambique, Suriname, and Uzbekistan.

Lagged share of bonds in PPG debt: This series had no major outliers.