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Local Currency Denominated Sovereign Loans

A Portfolio Approach to Tackle Moral Hazard and Provide Insurance

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February 2020

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Abstract

This paper studies how the currency composition of public debt affects debt sustainability in developing countries. We show empirically that the debt-to-GDP ratio tends to grow at a faster rate when countries with a high share of foreign currency debt face a currency depreciation. The paper also discusses the moral hazard problems associated with the presence of domestic currency debt and shows that, for the average country, there is no evidence of a positive correlation between local currency borrowing and inflation. However, moral hazard is a concern for countries with weak institutions where we find that a large share of domestic currency debt is associated with higher inflation. The paper also develops a stylized model that emphasizes the complementarities between foreign and local currency borrowing and highlights that they are complements rather than substitutes. The key intuition is that, while foreign currency debt reduces the incentives to debt monetization, local currency improves debt sustainability by providing a better hedge against external shocks. The paper concludes that the policy framework should consider encouraging a mix of foreign and domestic currency borrowing. This is likely to be particularly useful for low-income countries that are jointly characterized by weak institutions (hence, the importance of the commitment device associated with foreign currency debt) and large external shocks (hence, the importance of the insurance element associated with the presence of domestic debt).

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Executive summary

The COVID-19 crisis will have a massive effect on debt sustainability in developing countries. Higher healthcare costs, lower tax and export revenues and frozen debt markets will limit governments' ability to cover existing expenditure and refinance their maturing debts. The large capital outflows, the currency depreciation, fall in commodity prices, and economic slump associated with the COVID-19 crisis are likely to lead to a large number of debt crises. These problems are not due to policy failures in the developing world but to external factors including skyrocketing financing needs in advanced economies, elevated risk aversion among investors and a global economic slump.

This paper studies how the currency composition of public debt affects debt sustainability in developing countries. It shows that the debt-to-GDP ratio tends to grow at a faster rate when countries with a high share of foreign currency debt face a currency depreciation.

The study also highlights that the data are not consistent with the idea that, for countries with average policies and institutions, more local currency debt would lead to moral hazard problems. However, moral hazard is a concern for countries with weak institutions where a large share of domestic currency debt is associated with higher inflation.

The paper also develops a simple and stylized model that emphasizes the complementarities between foreign and local currency borrowing. The key intuition is that, while foreign currency debt reduces the incentives to debt monetization, local currency debt improves debt sustainability in bad times by providing a better hedge against economic fluctuations. The paper concludes that a mix of foreign and domestic currency debt is likely to be particularly useful for low-income countries that are jointly characterized by weak institutions (hence, the importance of the commitment device associated with foreign currency debt) and large external shocks (hence, the importance of the insurance element associated with the presence of domestic debt).

While an estimation of the optimal share of local currency debt for a sample of low-income countries goes well beyond the objectives of this paper, conversations with a number of practitioners and policymakers suggest that the share of domestic debt in many low-income countries is lower than what prescribed by their own medium-term debt strategies. It is also worth noting that all (or almost all) official lending from the World Bank, IDA, and other multilateral development banks is denominated in foreign currencies.

There are two possible reactions to this situation. The first is that what we observe is a market outcome and that the status quo is just a reflection of deeper problems driven by institutional failures. The second reaction is that the current situation is partly driven by historical accidents and that the status quo persists because of inertia and of a series of market and political failures. According to this view, good policies and institutions are a necessary but not sufficient condition for increasing access to local currency debt at reasonable interest rates: policy action to develop a market is needed.

The paper concludes with a discussion of the market, policy, and political distortions that may prevent low-income countries from increasing their share of local currency debt. Policy failures relate to the limited debt management capacity of many low-income countries and political failures related to the limited incentives of myopic and self-interested politicians to pay an "insurance' premium for a safer debt structure that may end up benefitting their successors.

1 Introduction

The COVID-19 crisis will have a massive effect on debt sustainability in developing countries. Higher healthcare costs, lower tax and export revenues and frozen debt markets will limit governments' ability to cover existing expenditure and refinance their maturing debts. The large capital outflows, the currency depreciation, fall in commodity prices, and economic slump associated with the COVID-19 crisis are likely to lead to a large number of debt crises. These problems are not due to policy failures in the developing world but to external factors including skyrocketing financing needs in advanced economies, elevated risk aversion among investors and a global economic slump.

This paper studies how the currency composition of public debt affects debt sustainability in developing countries. In other words, we ask if Dalio (2018, p.12) is right in claiming that: "when debts are denominated in foreign currencies rather than one's own currency, it is much harder for a country's policy makers to do the sorts of things that spread out the debt problems."

There is a long literature on the problems associated with balance sheet effects related to the presence of currency mismatches and on how the multilateral financial institutions could alter the structure of their balance sheets to mitigate the "original sin" problem (Eichengreen et al. 2005, Eichengreen and Hausmann, 2005). However, not much has been done so far, especially in the case of low-income countries. More than 15 years ago, Hausmann and Rigobon (2003) put forward a proposal aimed at dedollarizing lending by the International Development Association (IDA), and yet a recent IDA report on "Addressing Debt Vulnerabilities in IDA Countries," only includes a short paragraph on the desirability of local currency lending and it does not include a detailed analysis of the costs associated with foreign currency debt.

Anecdotal evidence on the dramatic effects of debt composition on debt sustainability is plentiful. For instance, focusing on the crises that hit Latin America at the turn of the century, Borensztein et al. (2006, p. 42) give the following examples:

> In December 1998, Brazil's net public debt stood at approximately 42% of GDP, but by January 1999 Brazil's public debt surpassed 51% of GDP. Could the Brazilian government have run a fiscal deficit of almost 10% of GDP in just one month? Uruguay presents another interesting case. In March 2002, Uruguay's debt was 55% of GDP, yet by the end of 2003 debt had soared to 110% of GDP. Could the Uruguayan authorities have run a deficit of 55% of GDP in less than two years? Finally, let's look at Argentina. In 2001 Argentina's debt was just above 50% of GDP. By 2002 Argentina's debt was well above 130% of GDP. Did Argentina really run a deficit of 80% of GDP in just one year?

Campos et al. (2006) move beyond anecdotal evidence and use data from 117 countries over a period of 30 years (1972–2003) to show how, among other things, debt composition influences debt explosions. The objective of this paper, which builds on Campos et al.'s (2006) work and expands and refines several of their exercises, is to reignite the debate by analyzing how the interaction between the presence of foreign currency debt and currency depreciations affects debt sustainability. The paper also discusses whether a mix of foreign and local currency debt can strengthen the borrowing position of a sovereign.

We start by describing our data and, *en passant*, making the case for greater data transparency (Section 2). Next, we show that the debt-to-GDP ratio tends to grow at a faster rate in countries with higher levels of foreign currency debt and that currency depreciations contributed to this effect. We also focus on debt explosion episodes and, again, show the importance of the interaction between the presence of foreign currency debt and currency depreciations using both standard regressions analysis and an event-study approach.

We then proceed with a simple analytical model that emphasizes the complementarities between foreign and local currency borrowing. The model shows that while foreign currency debt reduces the temptation to manipulate monetary policy, domestic currency debt helps to maintain borrowing countries afloat during bad times because it provides a better hedge against external shocks. This hedge act in addition to other forms of hedging, like extending debt maturity and liquidity support to guarantee prompt access to financial markets. Therefore, we show that both debt instruments, when jointly employed, enhance each other increasing sovereign debt sustainability. This result suggests that local currency debt is potentially very useful for low-income countries (LICs) where external shocks tend to be large, often connected to currency depreciations triggering debt distress.

We also conduct a series of empirical exercises aimed at evaluating whether the presence of local currency debt is a source of moral hazard. Specifically, we study the correlation between local currency borrowing and inflation and find that, for the average country, there is no evidence of a positive relationship between these two variables. However, moral hazard associated with a large share of domestic currency debt seems to be a source of concern for countries with weak policies and institutions. One challenge with these regressions is that they are based on the current situation in which most (if not all) local currency debt is issued domestically, and hence they cannot say much about a hypothetical situation in which a substantial share of local currency debt is in the hands of non-residents.

There are several caveats with our analysis. The most important issues relate to data quality, endogeneity, and to the cost of local currency borrowing.

As discussed in Section 2, there are serious issues with data availability and quality. While this is a problem in general, it should not be a great challenge for our results because the presence of measurement errors should bias our estimated coefficients toward zero.

The endogeneity problem is, instead, more serious. Our observations for debt levels, debt composition, inflation, and exchange rate movements are equilibrium outcomes and, without

valid instruments, we cannot make any causality claim. While we use lagged values of the main explanatory variables and control for a large number of confounding factors, we are aware that we cannot estimate causal relationships and hence abstain from making strong causality claims.

Finally, we analyze the costs of currency depreciations in the presence of foreign currency debt, but we do not study how domestic currency debt affects borrowing costs in tranquil periods. If this cost is very high, foreign currency debt could still be a good deal, even if it is riskier (from the borrowers' point of view) than domestic currency debt. In other words, having local currency debt might be optimal *ex-post* (after a crisis happens, as in Dalio's quote), but it is not clear whether domestic currency debt is also optimal *ex-ante*. This is a difficult question, and the answer depends on many country-specific factors. A full analysis of the costs *and benefits* of foreign currency borrowing goes well beyond the objective of this paper.[1] Such analysis would require, as a minimum, three elements: (i) an evaluation of the domestic currency equivalent of the *ex-post* cost of foreign currency borrowing (this cost is given by the sum of the dollar interest rate and the depreciation of the domestic currency vis-à-vis the US dollar); (ii) an estimation of the interest rate that would be charged in domestic currency; and (iii) an evaluation of the cost of debt crises associated with the presence of foreign currency debt.

If uncovered interest parity were to hold (at least on average) the domestic currency equivalent cost of foreign currency debt should be equal to that of domestic currency debt. If this were the case, a risk averse borrower would prefer more domestic currency debt. However, uncovered interest parity rarely holds and foreign currency debt is often cheaper than domestic currency debt. Therefore, even if distortions make local currency borrowing excessively costly, foreign currency borrowing may still not be optimal, as this cost may be worth paying in exchange for the valuable insurance benefits provided by long-term local

[1] The World Bank and the International Monetary Fund (2019) have jointly developed a Medium Term Debt Strategy (MTDS) tool aimed at helping countries to improve debt management over the medium term and the choice of the currency is a key factor in this strategy.

currency debt. The final decision would hinge, more generally, on the price that a sovereign is willing to pay to improve debt structure and limit the risks of foreign currency borrowing.

Any discussion of the costs and benefits of increasing the share of domestic currency needs to confront the standard objection to all proposals aimed at reforming the international financial architecture: if the current situation is not optimal, why don't markets work towards a solution?[2] We discuss these issues in the concluding section of this paper and highlight a series of market and political failures that may prevent countries from moving to a better equilibrium.

2 Debt Composition: Trends and Data

A first challenge in measuring the costs of foreign currency debt relates to obtaining information on debt levels and composition for a representative sample of low-income and developing economies. Abbas and Rogoff (2019) comprehensive survey of sovereign debt data shows that there is no dataset with historical information on the level and composition of public debt covering a large sample of low-income countries (there is, however, data on debt decomposition for advanced economies and a limited sample of emerging market countries).

[2] This is also related to the debate on whether the overwhelming presence of foreign currency debt is simply an outcome of bad policies and institutions as suggested by the "debt intolerance" view (Reinhart et al., 2003) or is it linked to a series of market and political failures as suggested by the "original sin" view (Eichengreen et al., 2003). The first view suggest that the situation can only be solved by improving the domestic policy framework, the second view suggest that good domestic policies are a necessary but not a sufficient condition for developing a thriving international market for debt denominated in the currencies of most developing countries. Related to this point, Tirole (2003) shows that there are conditions under which welfare is higher under foreign currency borrowing, even if this makes the country more exposed to adverse shocks. These conditions include imperfect coordination between the private and public sectors and time-inconsistent government choices. Tirole concludes advocating a different complementarity from the one that we study in this paper. Specifically, he focuses on complementarities "between corporate finance reform and government governance reforms" (p. 1681) and suggests that public policies that counter foreign borrowing have more appeal when domestic policies focus on investors' protection.

In this paper, we address this issue by using the same approach used by Panizza (2008). Specifically, we start from a dataset with information on debt-to-GDP ratios (an updated version of Abbas et al., 2010) and then we compute the share of foreign currency debt using information on public and publicly guaranteed (PPG) long-term external debt sourced from the World Bank's World Development Indicators. Specifically, we compute foreign currency shares by dividing the external PPG debt-to-GDP ratio by the total public debt-to-GDP ratio.

While, to the best of our knowledge, this is the only way to obtain historical data on the debt levels and debt composition for a large sample of developing economies, there at least three caveats with this approach:

1. The concepts of external debt and foreign currency debt do not necessarily coincide and World Bank data do not report the share of external debt denominated in domestic currency.[3] The available data divide total PPG debt into debt denominated in: US dollars; euro (French francs and Deutsche marks before the creation of the euro); Japanese yens; Pound sterling; Swiss francs; SDRs, multiple currencies; and all other currencies. For countries with an independent currency different from the ones just listed, the share of debt denominated in domestic currency is clearly a subset of the share of debt in the "multiple currencies" and "other currencies" categories. In practice, this should not be a serious issue because the other currencies and multiple currencies debt shares tend to be small (Figure 1). We will thus consider all external debt as being denominated in foreign currency. This assumption can lead to an

[3] There are three possible definitions of external (and thus, domestic) debt. The first focuses on the currency in which the debt is issued (with external debt defined as foreign currency debt). The second focuses on the residence of the creditor (external debt is debt owed to non-residents). The third focuses on the place of issuance and the legislation that regulates the debt contract (external debt is debt issued in foreign countries and under the jurisdiction of a foreign court). In theory World Bank data focuses on the second definition (The External Debt Statistics: Guide for Compilers and Users jointly published by the BIS, Eurostat, IMF, OECD, Paris Club, UNCTAD and the World Bank states that: "Gross external debt, at any given time, is the outstanding amount of those 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"). However, it is not clear whether compilers of debt statistics are indeed able to track the residence of the ultimate holders of sovereign bonds (Panizza, 2008).

overestimation of the foreign currency share (assuming that all "other currencies" debt is denominated in domestic would lead to the opposite problem).

2. The two datasets do not necessarily refer to the same level of government. While data on the total-debt-to-GDP ratio focus on central government or general government debt, the World Bank data also include publicly guaranteed debt. Moreover, the two datasets are compiled by different agencies. There are thus cases in which PPG debt is higher than total public debt. In these cases, we cap the share of external debt at 100%. This difference in coverage could lead to an over estimation of the foreign currency share.

3. While data on debt-to-GDP ratio refer to total public debt, World Bank PPG data only focus on long-term debt (defined as debt with an original maturity greater than 12 months). If a substantial share of short-term debt is denominated in foreign currency, the approach used in this paper will lead to underestimate the foreign currency share.

These considerations show that public debt data transparency and availability remain an important issue and are a key public good that the international community should provide. One way of validating our data is to compare them with the update of the Arslanalp and Tsuda (2014) dataset on the composition of securities issued by 15 emerging markets over 2004-19. The correlation between the two dataset is high but not perfect (the correlation coefficient is 0.5, and statistically significant at the 1% confidence level). In the Arslanalp and Tsuda (2014) dataset (which only includes government securities, hence excludes lending by commercial banks and the multilateral financial institutions) 73% of the debt is issued in domestic currency while in our dataset the share of domestic currency debt is 59% (these are simple averages for the country-years for which the two dataset overlap). While for most country-years, Arslanalp and Tsuda (2014) report higher domestic debt shares (in the median country-year the domestic debt share is 13 percentage points higher in the Arslanalp and Tsuda data), for about 30% of observations, our data suggest higher domestic

currency debt shares than in Arslanalp and Tsuda (2014). Figure A1 and Tables A2-A4 in the Appendix compare our data with those of Arslanalp and Tsuda (2014).

Table 1 shows that while our data only covered 53 countries in 1970, coverage has improved with time, reaching 107 countries in 2010. In 2017, (the last year for which we have complete data), our dataset covered 102 countries (25 low income, 37 lower middle income, and 40 upper income). The table also shows that the composition of countries has changed over time. While at the turn of the century, about 50% of the countries included in our data were classified as low income and only 12% were classified as upper middle income, by 2017 about one-quarter of countries were classified as low-income and nearly 40% of countries were classified as upper middle income. These changes in the share of low-income countries are not due to changes in the sample, but to the fact that several countries graduated from low-income and lower middle-income status.

Table 2 shows the evolution of debt levels and composition for different group of countries. The top panel shows that the average total debt-to-GDP ratio decreased from 76% in 2000 (99% for low-income countries) to 45% in 2014 and then started increasing again, reaching 53% in 2017 (50% in low-income countries).[4] The GDP-weighted averages of the bottom panels of the table show lower debt ratios (48% in 2000 and 44% in 2017), suggesting that smaller countries tend to have higher debt levels.

In terms of debt composition, in 2000 about 88% of debt was external (89% for low-income countries), with the average share of external debt dropping to 78% in 2017 (70% in low-income countries). Data on weighted average suggest that larger countries have lower external debt shares (in line with the results of Eichengreen et al, 2007). At the turn of the century, the weighted average for the external debt share was 80% (67% for low-income countries) and in 2017 this weighted average had dropped to 69% (it had, however, increased to 74% in low income countries). Figures 1 and 2 show that, while the decrease in the share

[4] The drop in debt was partly due to the HIPC and MDRI initiatives, the debt-to-GDP ratio of low-income countries dropped to 38%; Figures 1 and 2 show the drop in external debt associated with these initiatives

of external debt was due to both a decrease in total external debt (partly associated with the HIPIC and MDRI initiatives) and an increase in domestic currency borrowing, the former effect dominates the latter.

Figures 3 and 4 plot the evolution of debt composition in low-income countries, lower middle-income countries, and upper middle-income countries. As already suggested by Table 2, they show that the reduction of foreign currency debt over the las 20 years was mostly a low-income country phenomenon (and, to some extent, lower middle-income country), driven by the debt relief initiatives launched at the turn of the century. Over the same period, the share of domestic public debt was instead decreasing in upper middle countries.[5]

Note that while in this section we focus on the domestic versus foreign debt split, in recent years there have also been important changes in debt composition along other dimensions. For instance, Pinto (2019) shows that the borrowing dynamics of low-income countries have changed substantially, shifting from being mainly official external debt towards more borrowing from the commercial lenders (both domestic and international). This shift in debt composition requires a reconsideration of the key variables to consider in the analysis of debt sustainability. In fact, the World Bank-IMF Debt Sustainability Framework for low-income countries has been revised in 2018 with the objective to address some of the challenges posed by this shift in debt composition and now puts greater emphasis on total public debt and on the growing role of market-based financing.

3 Foreign currency debt and debt growth

We now check whether currency composition has an effect on the evolution of the debt-to-GDP ratio and how currency composition interacts with the evolution of the nominal exchange rate in driving this ratio. We start by estimating the following model:

[5] This is the case for the simple average; weighted data show that the share for domestic debt decreased between 1990 and 2000 and increased slightly over 2000-2017.

$$\Delta d_{t,i} = \alpha + \beta d_{t-1,i} + X_{t,i}\Gamma + \delta DXR_{t,i} + \theta FXD/TD_{t-1,i} + \varepsilon_{i,t} \qquad (1)$$

Where $\Delta d_{t,i}$ is the variation in the debt-to-GDP ratio in country i, and year t ($\Delta d_{t,i} = d_{t,i} - d_{t-1,i}$), $d_{t-1,i}$ is the lagged value of the debt-to-GDP ratio, $X_{t,i}$ is a matrix of control variables that include standard determinants of debt growth (GDP growth, primary balance, inflation, and interest payments) and country's level of development (the log of GDP per capita), $DXR_{t,i}$ is the percent change of the exchange rate ($DXR_{t,i}$= $\ln(XR_{t,i}/XR_{t-1,i})$, a positive value is a currency depreciation), and $FXD/TD_{t-1,i}$ is the share of foreign currency debt in period $t-1$ (defined as total external debt over total public debt; see Section 2 for a discussion of who this share was computed). Table A1 in the appendix provides details on data sources and definitions.

Column 1 of Table 3 shows that the initial debt level is negatively correlated with debt growth (a standard result showing that debt has a non-explosive path). Real GDP growth is negatively correlated with debt growth and so is inflation (this is also standard, since nominal GDP is in the denominator of the debt-to-GDP ratio). We also find that, as suggested by the standard debt-dynamic equation, the primary balance is negatively correlated with debt growth and interest payments are positively correlated with debt growth. GDP per capita, instead is not statistically significant. As the model does not include country fixed effects, this latter result suggests that there are no differences in debt growth between richer and poorer countries. We also find that currency depreciations are positively correlated with debt growth and so is the share of foreign currency debt. It is worth noting that our model explains about one-third of the variance of debt growth (the R^2 is 0.34) even though the model includes all the element of standard debt-dynamic equation and, in theory, should explain 100% of the variance of debt growth. Campos et al. (2006) discuss the reasons for this relatively poor fit of debt-dynamic equations.

To check whether currency depreciations are particularly costly in the presence of foreign currency debt, we augment our baseline model with the interaction between these two variables. Formally, we estimate the following equation:

$$\Delta d_{t,i} = \alpha + \beta d_{t-1,i} + X_{t,i}\Gamma + \delta DXR_{t,i} + FXD/TD_{t-1,i}\left(\theta + \phi DXR_{t,i}\right) + \varepsilon_{i,t} \qquad (2)$$

In this set up, the parameter ϕ captures the differential effect of currency depreciations for countries with high and low foreign currency debt shares. A positive value of ϕ would suggest that currency depreciations lead to higher debt growth in countries with a larger share of foreign currency debt.

Column 2 of Table 3 estimates equation 2 and shows that, while the parameter estimates for the main control variables are unchanged, the interactive coefficient is positive and statistically significant and the inclusion of the interactive term affects the estimates of δ and θ. Specifically, we now find that $DXR_{t,i}$ has a negative coefficient. This result suggests that in countries with no external debt, depreciations are associated with a debt reduction. We also find that debt composition ($FXD/TD_{t-1,i}$) is no longer statistically significant, indicating that the share of foreign currency debt does not matter for debt growth when the exchange rate does not move. As mentioned, the interactive coefficient is positive and highly significant. This latter result indicates that depreciations lead to debt increases in countries with more foreign debt. The left panel of Figure 6 provides a graphic interpretation for the results of Table 3. The solid line plots the relationship between debt growth and currency depreciations at different shares of foreign currency debt (the shaded area is a 95% confidence interval around these estimates). The graph shows that the relationship between exchange rate movements and debt growth is not statistically significant for countries where less than 40% of public debt is denominated in foreign currency, but that this relationship becomes positive and statistically significant for countries with larger shares of foreign currency debt. The point estimates suggest that in countries where 100% of debt is denominated in foreign currency a 10% currency depreciation is associated with an increase in public debt of approximately 5 percentage points of GDP.

Column 4 of Table 3 shows that the results of column 2 are robust to using the lagged value of $DXR_{t,i}$, column 5 shows that the results are robust to only using low income and lower middle income countries, and column 6 shows that the results are robust to restricting the sample to low-income countries.

Our results could be driven by country-level unobservable shocks that are correlated with debt composition and debt growth or by global shocks that may jointly affect debt levels and exchange rate movements. To address these issues with augment our model with a full set of country fixed effects (which control for all possible time-invariant country level effects) and time fixed effects (which control for all possible time-variant but country-invariant global shocks). Table 4 and the right panel of Figure 6 show that the results of the fixed effects regression are basically identical to those of the baseline model.

Although the result that the interaction between debt composition and currency movement is linked to debt growth is not unexpected, to the best of our knowledge, this is the first time that this result is obtained for a sample of low-income countries. It is also worth noting that our results suggest that there is no complete tradeoff between currency composition and debt maturity. If domestic currency debt had very short maturity, interest rates would immediately incorporate the expectations of a currency depreciation negating its effect on debt growth. Finally, the presence of massive measurement error in our data on debt levels and composition should bias our estimates towards zero.

4 Foreign currency debt and debt explosions

So far, we showed that the interaction between debt composition and currency depreciation has important implications for debt growth. We now check if this is also the case if we focus on extreme events.

We start by defining debt explosions as events in which the debt-to-GDP ratio increases by at least 10 percentage points (the top 10% of the distribution of debt growth). We then create a dummy that takes value 1 in years of debt explosions and 0 in other years.[6]

We then estimate equations 1 and 2 using this dummy as dependent variable (we use a linear probability model because interactions are difficult to interpret with probit and logit regressions). Tables 5 and 6 show that the results of Tables 3 and 4 are robust to focusing on debt explosions.

To illustrate the behavior of the exchange rate around debt explosions, we build an exchange rate index that takes value 100 in the year of a debt explosion and plot the behavior of this index (both in levels and logs) around the debt explosion.[7] The graphs in the top panels of Figure 7 show the average behavior (with 95% confidence intervals) of the exchange rate around debt explosions for all countries in our sample (the left graph plots the log of the index and the right graph plots the index itself). They show that currency depreciations both precede and follow debt explosions. The bottom panels of the figure show that we obtain the same result if we restrict the sample to low income and lower middle-income countries and to only low-income countries.

Figure 8 conducts a similar exercise but it now splits the sample between countries with high shares of foreign currency debt (the black line) and lower shares of foreign currency debt (the gray line). In this exercise, a high foreign currency debt country is defined as a country with a share of foreign currency debt share greater than 60% in the year before the episode. The figures show that when we focus on the behavior of the exchange rate after a debt explosion episode there are no differences between the two groups of countries. However, the depreciation that precedes the episode is significantly larger in countries with higher

[6] If there are several consecutive debt explosions, we only consider the first one and we also drop all country-years around debt explosions (in the baseline we consider a 6-year window around the debt explosions, but we also consider windows of different length).
[7] For this exercise, we only consider the first of a series of consecutive debt explosions, but do not drop years around the window.

levels of foreign currency debt. In other words, currency depreciations are stronger predictors of debt explosions in countries with high levels of foreign currency debt.

Table 7 provides a formal test for the results of Figure 8 by reporting the results of the following regression:

$$DE_{i,t} = \alpha + \sum_{n=3}^{1} \ln(XR_{t+n,i})\left(\beta_n + \delta_n FX_{t-1,i}\right) + \\ + \sum_{n=-3}^{-1} \ln(XR_{t+n,i})\left(\beta_n + \delta_n FX_{t-1,i}\right) + \varepsilon_{i,t} \quad (3)$$

In the first three columns of the Table, $FX_{t-1,i}$ is defined as a dummy variable taking value 1 if the share of foreign currency debt the year before the explosion episode is greater than 60%. In the last three columns, $FX_{t-1,i}$ is a continuous variable that measures the share of foreign currency debt in the year before the debt explosion episode. The vector of δ_n parameters measures how the correlation between exchange rate and debt explosion differs between countries with high and low levels of foreign currency debt. As suggested by Figure 8, we find that in the year before the debt explosion this correlation is always larger (in absolute value) for countries with higher shares of foreign currency debt (δ_{n-1} is negative and statistically significant). When we measure the share of foreign currency debt with a dummy variable (columns 1-3), we find that there is no statistically significant difference in any other period. When we use a continuous measure for the share of foreign currency debt, we find that the correlation is stronger for high foreign debt countries also two and (for low-income countries) three years before the debt episode (both δ_{n-1} and δ_{n-2} are negative and statistically significant). Crucially, we find that the share of foreign currency debt never affects the post-episode correlation between the exchange rate and debt explosion (i.e., δ_{n+1}, δ_{n+2}, and δ_{n+3} are never statistically significant). Countries with more foreign currency debt do not suffer larger depreciations after debt crises.

5 Local and foreign currency borrowing: a portfolio approach

Our empirical analysis so far has emphasized how debt sustainability in developing and low-income countries is exposed to exchange rate volatility and sudden depreciations. Sovereign debt in local and foreign currencies are often viewed as competing instruments. While some degree of substitutability between these two types of debt exists, this paper underscores that the two debt instruments should be viewed as complements because each of them faces a different trade-off.

If foreign currency debt reduces the incentive to manipulate monetary policy in order to cut the real value of payments to creditors, debt in local currency, by providing a better hedge against economic fluctuations, helps maintaining borrowing countries afloat during bad times. By doing so, combining the two types of debt increases the sustainability of a sovereign debt positions. This is particularly important since depreciation shocks - often unrelated to country specific policy or fundamentals - are conducive, as our empirical analysis just emphasized, to sudden surges in the debt ratios.

The general argument is that, while debt in international currency provides a discipline device against moral hazard, debt in local currency insures the borrower against adverse phases of the business cycle that are, more often than not, accompanied by large domestic currency depreciations. It is therefore misleading to argue that the value to creditors - i.e. the probability of swift and complete repayment - depends only on limiting moral hazard, since it also depends on the sustainability of the stock of debt during downturns. In bad times, often associated with local currency depreciation, foreign currency borrowing may amplify the cost of the business cycle by making repayment more costly, exactly when the economy is weaker. Creditors may thus be protected against currency depreciation but they are not protected against default risk.

A simple analysis of the sovereign borrower intertemporal constraint can clarify the argument. Every country issuing public debt has to balance the need to borrow with the cost of borrowing. This trade-off can be clarified by inspecting the sovereign budget constraint at

time *t* when the government issues both international currency, D^*, and domestic currency debt, *D*, at the nominal price q^* and *q*, respectively:

$$D_{t-1} + D^*_{t-1} = q_t D_t + q^*_t D^*_t + (T_t - G_t) \quad (4)$$

and the government runs a primary budget balance $(T_t - G_t)$. Normalizing every variable in terms of nominal GDP, *Y*, we have:

$$\frac{D_{t-1}+D^*_{t-1}}{Y_{t-1}*g_t} = \frac{q_t D_t + q^*_t D^*_t}{Y_t} + \frac{(T_t - G_t)}{Y_t} \quad (5)$$

where g_t is the growth rate of nominal GDP. This budget constraint can be written in compact form as:

$$\frac{d_{t-1}}{g_t} + \frac{d^*_{t-1}}{g_t} + pd_t = q_t d_t + q^*_t d^*_t \quad (6)$$

where pd_t represents the primary deficit as a share of GDP. Given the state of the economy and the conduct of fiscal policy (i.e. the primary deficit), the sovereign borrower can, in principle, choose between any combination of local and international currency debt. The cost of either debt instrument depends on a common factor, i_t, capturing the world interest rate and country risk and instrument-specific factors. Specifically:

$$\frac{1}{q_t} = i_t + (1/\lambda_t) + \pi_t \quad (7)$$

where λ_t labels the level of liquidity and financial depth in the market for local currency debt, π_t labels actual inflation. While it is standard to assume that creditors wants to be compensated for the opportunity cost of capital, i_t, and actual inflation, π_t, i.e. the real interest rate, the intuition behind the inclusion of λ_t in the pricing equation requires some additional explanation. This factor captures investors' overall appetite for local currency debt

and therefore depends on two fundamental factors: first, the level of financial depth in domestic markets, including the level of local savings and financial repression, and, second, the availability to financial investors of hedging instruments against domestic currency fluctuations. Equation (7) illustrates how all these factors combined - summarized by λ_t - affect the pricing of sovereign debt in local currency determining the actual cost to the borrower.

By a similar conventional logic, the pricing of foreign currency sovereign debt can be expressed as:

$$\frac{1}{q_t^*} = i_t + \Delta e_t \qquad (8)$$

where Δe_t is the depreciation of the domestic currency.[8] Moreover, in order to capture the effective cost of debt and anticipate its dynamics, we must consider nominal GDP growth, g_t. This can be split into real growth, γ_t, and actual inflation so that we have:

$$g_t = \gamma_t + \pi_t \qquad (9)$$

To fix ideas, let us consider the typical case of a country-specific negative shock and the needed policy responses. The easiest way to capture such shock is an increase in primary deficit (pd_t) in (8). This can be due to a drop in tax revenues or an increase in public spending related to a recession or political uncertainty. Monetary expansion, in the form of partial or complete debt monetization, might then become an option to meet creditors' demands in the short run and avoid a liquidity crisis.

Let us consider this option in the two extreme cases: (i) where the country issues foreign currency debt ($d_t = 0 \; \forall t$) and (ii) where the country only issues domestic currency debt

[8] Even though any depreciation of the local currency also has an effect on the repayment cost of outstanding debt and not only on the refinancing through future debt, for simplicity we will summarize the overall impact on the budget constraint with the latter effect. It is easy to show that this is without loss of generality.

($d_t^* = 0\ \forall t$). In the first case, substituting for the equilibrium condition for foreign currency bond price and nominal GDP growth, we obtain:

$$\frac{d_{t-1}^*}{g_t} + pd_t = q_t d_t$$

$$\leftrightarrow$$

$$(d_t^* - d_{t-1}^*) = \frac{(i_t + \Delta e_t - \gamma_t - \pi_t)}{\gamma_t + \pi_t} d_{t-1}^* + pd_t(i_t + \Delta e_t) \qquad (10)$$

In the second case, we have:

$$\frac{d_{t-1}}{g_t} + pd_t = q_t d_t$$

$$\leftrightarrow$$

$$(d_t - d_{t-1}) = \frac{\left(i_t + \left(\frac{1}{\lambda_t}\right) - \gamma_t\right)}{\gamma_t + \pi_t} d_{t-1} + pd_t \left(i_t + \left(\frac{1}{\lambda_t}\right) + \pi_t\right) \qquad (11)$$

Rewriting the intertemporal budget constraint in (11) allows clarifying the relevant trade-off between the incentives to monetize and the need for insurance. To flesh out the issue, let us consider the case when the monetary authority responds to the negative shock by monetizing public debt and increasing the money supply. This decision has two separate but connected effects: it increases inflation and depreciates the international value of the currency. We want to study the effect of this decision on the sustainability of government debt under the two alternative financing scenarios described above.

It is important to observe that the speed at which prices adjust during debt monetization is essential to study its consequences. In fact, in the presence of even a minimal degree of price rigidity, investors' expectations would adjust in response to the increase in not only current but also future inflation. Since expectations adjust more quickly than current prices, i.e. current inflation, exchange rate depreciation raises above the increase in current inflation.[9]

[9] This is just an observation in line with the seminal *overshooting* model (Dornbusch, 1976).

This is equivalent to saying that the current value of the exchange rate, and therefore its rate of depreciation, is affected more than current prices, and thus current inflation, by the monetary expansion. Formally:

$$\Delta e_t > \pi_t \tag{12}$$

This assumption, consistent with the empirical evidence for the presence of sticky prices, delivers a clear implication in the context of the currency composition of sovereign debt. In an economy where the sovereign borrower only issued foreign currency debt, the intertemporal budget constraint for the government in (13) shows that any monetization of the crisis increases the real burden of sovereign debt because the cost of refinancing debt (*debt rollover*) grows more than nominal GDP (*debt dilution*). This implication depends only on the assumption of nominal price rigidity (the inequality in equation 12). This can be observed by studying the following expression for the government's intertemporal budget constraint:

$$(d_t^* - d_{t-1}^*) = \frac{(i_t + \Delta e_t - \gamma_t - \pi_t)}{\gamma_t + \pi_t} d_{t-1}^* + pd_t(i_t + \Delta e_t) \tag{13}$$

In the economy with only domestic currency debt, instead, the monetization of public debt affects the cost of refinancing debt (*debt rollover*) and nominal GDP (*debt dilution*) differently depending on the relationship between the nominal interest rate and nominal GDP growth. If the nominal interest rate is larger than nominal GDP growth, an increase in inflation will increase the cost of debt rollover less than debt dilution. This implies that debt monetization allows dealing with the negative real shock – a surge in pd_t – effectively and differently from the case of foreign currency debt. In order to confirm this observation, it suffices to observe the intertemporal budget constraint to note that, for an increase in the inflation rate π_t, the existing debt will be diluted more than the increase in the cost of rolling it over as long as real GDP growth – γ_t – is larger than the real interest rate – $\left[i_t + \left(\frac{1}{\lambda_t}\right)\right]$:

$$(d_t - d_{t-1}) = \frac{\left(i_t + \left(\frac{1}{\lambda_t}\right) - \gamma_t\right)}{\gamma_t + \pi_t} d_{t-1} + pd_t \left(i_t + \left(\frac{1}{\lambda_t}\right) + \pi_t\right) \qquad (14)$$

Since debt monetization increases the cost of debt in foreign currency while it might decrease the real burden of local currency debt, it has become conventional to view local currency debt as a source of moral hazard leading to the temptation to monetize public debt. This perspective has convinced policy makers to discourage sovereign borrowers at middle and especially low-income levels from issuing local currency debt. This perspective does not consider that often there is domestic support in favour of low inflation. Most advanced economies, for instance, have their debt fully denominated in domestic currency and no clear temptation to inflate it away.

However, our simple analytical model suggests that the temptation to inflate away the debt can also be mitigated if there is domestic support in favour of low inflation. The model asks if it is possible for a sovereign borrower to issue local currency debt without incurring into the incentive to monetize its debt obligations. It concludes that it is not only possible but also convenient to issue local currency debt if one adopts a portfolio approach perspective. If local currency debt is accompanied with foreign currency debt, foreign currency debt acts as commitment device against debt monetization. If foreign currency debt is large enough in the general composition of public debt, a sovereign borrower might very well find it too costly to monetize its debt because of the surge in the cost of rolling over foreign currency debt. Because of this induced commitment, the sovereign would, at the same time, find it optimal to issue local currency debt sheltering itself from the external shocks on its exchange rate without the temptation to inflate this kind of debt away. Local currency debt repayments are in fact unaffected by depreciation shocks.

In conclusion, it turns out that local currency debt becomes more sustainable and less prone to monetization, the more it is accompanied with foreign currency debt. At the same time, because foreign currency debt facilitates the issuance of local currency debt, it increases the overall sustainability of the overall debt position by enhancing the insurance against external

shocks. In this portfolio perspective, the two debt instruments become complementary and, while foreign currency debt serves as *collateral* against monetization of local currency debt, it also allows the sovereign borrower to insure itself against depreciation shocks through the issuance of domestic currency debt.

Finally, the optimal share of domestic currency debt will also depend on domestic institutions and preferences. In a setting in which there are strong domestic preferences for low inflation, a lower share of foreign currency debt will be necessary to lessen the government incentive to monetize. Throughout our conceptual analysis, we have also assumed that any debt monetization increases current and future inflation in a very similar way. This is equivalent to assuming that, after a monetary shock, inflation adjusts rather quickly to its long run value.

6 Local currency debt and moral hazard

One standard argument highlighted above is that the presence of local currency debt could generate incentives to inflate away the debt. This is the standard moral hazard argument. Testing for moral hazard is difficult because endogeneity and reverse causality concerns are paramount. It is, however, possible to check whether there is a correlation between the presence of local currency debt and inflation and test whether the evolution of local currency debt predicts inflation or the other way around. We start by estimating the following model:

$$\ln (CPI)_{t,i} = \beta \ln (CPI)_{t-1,i} + \delta \frac{DD_{t-1}}{TD_{t-1}} + \alpha_i + \tau_t + \varepsilon_{i,t} \qquad (15)$$

Where $\ln (CPI)_{t,i}$ is the log of the consumer price index, $\frac{DD}{TD}$ is the share of domestic debt over total debt, and α_i and τ_t are a set of country and year fixed effects.

Column 1 of Table 8 shows that there is no correlation between lagged debt composition and inflation. In column 2, we control for the debt-to-GDP ratio and find that while this variable is positively correlated with inflation, the coefficient of debt composition remains

insignificant. In column 3, we interact debt composition with debt levels to check whether countries with higher debt levels have a stronger temptation to inflate away the debt (this regression is equivalent to jointly controlling for the domestic debt to GDP ratio and the foreign debt to GDP ratio). Formally, we estimate the following regression:

$$\ln (CPI)_{t,i} = \beta \ln (CPI)_{t-1,i} + \frac{DD_{t-1}}{TD_{t-1}}\left(\delta + \gamma \frac{TD_{t-1}}{Y_{t-1}}\right) + \theta \frac{TD_{t-1}}{Y_{t-1}} + \alpha_i + \tau_t + \varepsilon_{i,t} \qquad (16)$$

where $\frac{TD_{t-1}}{Y_{t-1}}$ is the debt-to-GDP ratio. In this set-up, the parameter γ measures whether the correlation between the share of domestic debt and inflation is affected by the level of public debt. A positive value of γ would be consistent with the idea that, in the presence of domestic currency debt, countries with higher debt levels have a stronger incentive to inflate. When we estimate equation (16), we still find that debt levels matter, but debt composition does not matter: neither the interactive coefficient nor the main coefficient for debt composition are statistically significant (see also Figure 9).

It is also possible that the temptation to inflate is stronger for countries with weak policies and institutions. To check for this possibility, we interact debt composition with a time invariant measure of the World Bank index of country institutions and policies (CPIA, note that since we use a time-invariant index the country fixed effects fully absorb its main effect).

Column 4 of Table 8 shows that this interactive term is negative and highly significant. The regression's results suggest that in countries with below average institutions and policies (in our sample, the cross-country average of the index is 3.2) a higher domestic debt share is associated with higher inflation in the next period, but that the opposite is true for countries with good institutions and policies (see Figure 10). This result is robust to also including the interaction between debt composition and debt levels (column 5 of Table 8).

It is possible that the lack of a strong correlation between domestic debt share and inflation is driven by the presence of financial repression as countries may not need to inflate away

their debt whenever local banks are forced to buy it. It is worth noting that the opposite could also be true. In the presence of financial repression, a country could inflate away its debt by imposing high negative interest rates while still being able to place its debt with domestic investors which do not have alternatives. Be as it may, we check whether our results are driven by financial repressions by looking at the role of capital control and credit to the private sector.

Table 9 estimates the same models of Table 8 for all country-year with a level of the updated version of the Chinn and Ito (2006) index which is above the sample median. As the Chinn and Ito index measures a country's degree of capital account openness, it is reasonable to assume that the presence of financial repression is negatively correlated with this index. The first three columns of this table (which only includes observations with low financial repression) are qualitatively identical to those of Table 8. In the last two columns, we find that the domestic debt share and its interaction with the CPIA index are no longer statistically significant. This finding suggests that, while the quality of policies matters for the countries with a closed capital account, in countries with an open capital account there is no correlation between debt shares and inflation, independently of the quality of policies and institutions. In Table 10, we repeat the experiment by focusing on country-years with below the median levels of capital account openness and, as expected, we find that in this case good policies and institutions reduce the correlation between domestic debt share and inflation.

Next, we estimate the models of Table 8 by splitting the sample between country-years with above and below average credit to the private sector. If a well-developed domestic credit market is negatively correlated with the presence of financial repression, we should expect that the correlation between domestic debt and inflation is weaker in countries with low credit to the private sector. Tables 11 and 12 find results that are qualitatively similar to those of Table 8. However, the coefficient for the interaction between the CPIA index and debt composition tends to be larger in countries with low levels of credit to the private sector, confirming that good policies are more important in mitigating the possible inflationary bias

of domestic debt in countries with small credit markets and, possibly, high levels of financial repression.

After having established that the correlation between domestic debt share and inflation only exists for countries with weak policies and institutions and a relatively closed capital account, we explore the dynamic of the correlation between these variables. We start by estimating impulse-responses with Jordà's (2005) local projections method in a panel data model with two lags and country and year fixed effects.

Figure 10 (left panel) suggests that higher levels of inflation are associated with less domestic currency debt on impact. However, inflation does not seem to have a statistically significant impact on future debt composition. The right panel of figure 10, instead, suggest that higher levels of domestic debt are associated with lower future inflation (the coefficient is statistically significant up to two years in the future). Note that this result is the opposite of what one would expect if countries with more local currency debt had an incentive to inflate the debt away. Of course, these results could be driven by reverse causality: past inflation increase credibility which, in turn, leads to a greater ability to issue local currency debt at low interest rates.

We also experiment with a bivariate vector autoregressive model (VAR) model. As before, we focus on log CPI and the share of domestic public debt, and we estimate a panel VAR with country and year fixed effects and four lags.[10]

We start with a standard Granger Causality test that, in the full sample of countries, rejects the null that the two variables do not Granger-cause each other (top panel of Table 13). We find the same result if we focus on lower-middle income countries and low income and lower middle-income countries (the bottom two panels of Table 13). However, in the sample of

[10] This is the lag length selected by the Schwarz-Bayesian information criterion; the Hannan–Quinn and Akaike information criteria suggest 8 and 9 lags, respectively.

low-income countries, we do not reject the null that debt composition does not Granger cause inflation (second panel of Table 13).

Next, we use the full sample and build impulse response functions with two different ordering. When we order debt composition first, we find that a shock to inflation has no effect on the share of domestic currency debt (top left panel of Figure 11) and that a shock to debt composition reduces future inflation (top right panel of Figure 11).[11] When we order log CPI first, we find that a shock to inflation reduces the future share of local currency debt (bottom left panel of Figure 11, this is the same as what we found in the local projections of Figure 10) and that a shock to debt composition has no impact on inflation. Clearly, the ordering matters. However, whatever ordering we choose, we never find that a larger share of domestic currency debt is associated with more inflation.

One challenge with the results of this section is that they are based on the current situation in which most (if not all) local currency debt is issued domestically, and hence they cannot say much about an hypothetical situation in which a substantial share of local currency debt is in the hands of non-residents.

7 Conclusions

This paper shows that foreign currency borrowing poses risks to debt sustainability. Specifically, we show that the debt-to-GDP ratio tends to grow at a faster rate when countries with a high share of foreign currency debt face a currency depreciation. The paper also discusses the moral hazard problem associated with the presence of domestic currency debt. It shows that, on average, there is no positive correlation between local currency borrowing and inflation. However, there is substantial cross-country heterogeneity. In countries with good policies and institutions, higher domestic debt shares are associated with lower inflation, possibly because in these countries a higher share of domestic debt is associated

[11] This is the same as what we found in the local projection exercise of Figure 10.

with a constituency of domestic debtholders who prefer low inflation.[12] However, moral hazard is a concern for countries with weak institutions. In this case, we find that a large share of domestic currency debt is associated with higher inflation. Note, however, that this result only holds for countries with a relatively closed capital account (a measure of financial repression). With an open capital account there is no correlation between inflation and domestic debt issuance even for countries with poor policies and institutions.

The paper also develops a stylized model that emphasizes the complementarities between foreign and local currency borrowing. The key intuition is that, while foreign currency debt reduces the incentives to debt monetization, local currency debt improves debt sustainability in bad times because, debt explosions are often associated with depreciation episodes.

While an estimation of the optimal share of local currency debt for a sample of low-income countries goes well beyond the objectives of this paper, the policy debate among practitioners and policymakers suggests that the share of domestic debt in many low-income countries is lower than what prescribed by their own medium-term debt strategies. It is also worth noting that none of these countries has access to external funding in local currency. Hence, all domestic currency funding is locally sourced, with possible negative implications for access to credit by the private sector (moreover, local funding is useless for countries that need external funds to close their financing gaps). All (or almost all) official lending from the World Bank, IDA, and other multilateral development banks is denominated in foreign currencies.

There are good reasons why the multilaterals tend to lend in dollars. As prudential practices in multilateral development banks do not allow taking currency risk, lending in domestic currency needs to be backed by domestic currency borrowing. In theory, the IFIs should be able to borrow at cheaper rates with respect their clients characterized by higher credit risk. In practice, this is rarely the case. Even, when there is a pricing advantage in local currency,

[12] This would be in line with the literature suggesting that countries with preferences for low inflation build institutions which support low inflation (Brumm, 2011).

this pricing advantage is much lower than the pricing advantage in foreign currency (Perry, 2009). Multilateral development banks seem to have a comparative advantage in borrowing and lending in foreign currency, where the only things that matter is credit risk.

There are two possible reactions to this situation. The first is that what we observe is a market outcome and that the status quo is just a reflection of deeper problems driven by lack of macroeconomic credibility, poor contract enforcement and other institutional failures. While the outcome might be inefficient, one must conclude that nothing can be done without addressing the underlying institutional failures. The second reaction is that the current situation is partly driven by historical accidents and that the status quo persists because of inertia and a series of market and political failures. If this is the case, international reforms and coordination among policymakers can move the "international financial architecture" towards a better equilibrium. According to this view, good policy and institutions are a necessary but not sufficient condition for increasing access to local currency debt at reasonable interest rates.

While, we do not have a good theory of market creation, there are plenty of examples of markets that were created, sometimes serendipitously, by a policy action. A classic example in the field of sovereign debt is the re-birth of the international bond market for emerging market countries after the Brady deals of the early 1990s.[13]

The fact that a policy action may be necessary is due to the presence of externalities linked to the creation of new debt instruments and contracts. As markets needs to learn how to trade, price, and structure these instruments, the first issuer absorbs the fixed cost of designing the instrument and the other players can copy the innovator without the need of paying royalties. Market participants may decide to invest in financial innovation in large emerging market countries (such as Brazil, Mexico or Indonesia) and then try to exploit their first mover advantage, but this is unlikely to happen for smaller economies with shallow capital markets.

[13] A discussion of innovations in sovereign bond markets can be found in Borensztein and Mauro (2004).

While externalities are a problem for commercial lenders, they should not be an issue for a multilateral financial institution like the World Bank Group that have a mandate to provide public goods.

While multilateral financial institutions do not appear to have an advantage in issuing local currency bonds of their borrowing countries, they may have such an advantage in developing new indexed instruments. Eichengreen et al. (2002) and Eichengreen and Hausmann (2005) suggest that the World Bank and other multilateral development banks could issue bonds denominated in a real (i.e., indexed to inflation) emerging market currency index and then use the proceeds to extend local currency inflation-index loans to their clients. Such a policy would have two advantages: (i) it would let the multilateral to lend in local currency (albeit indexed to prices) without taking a currency risk and (ii) it could create a market for such instruments that could then be tapped by other types of issuers. Although Eichengreen and Hausmann (2005) showed that such a bond would have desirable risk-return features and the proposal has been discussed in several high-level seminar, multilateral financial institutions have not yet made any move in this direction.

Hausmann and Rigobon (2003) put forward a similar proposal explicitly targeted to IDA (and, more in general, concessional) lending. These authors start by recognizing that while the IBRD window of the World Bank tends to lend in dollars because it issues most of its debt in dollars, the IDA window, mostly funded with fiscal transfers and retained World Bank Group earnings, could in principle lend in any currency. Hausmann and Rigobon (2003) suggest that IDA should lend in inflation-indexed domestic currency and show that this would not have large budgetary implication for IDA. In fact, they suggest that such a portfolio could generate higher returns than a dollar denominated portfolio.[14] Bachiocchi and Missale

[14] Hausmann and Rigobon (2003) argued that switching to inflation indexed local currency would increase likelihood of repayment because the debt burden would be larger in good periods and smaller in bad periods, improve risk management for low-income countries and only have a minor overall impact the IDA portfolio's dollar value. dePlaa and Yi (2005) find that switching to inflation index local currency would indeed generate benefits for borrowing countries as it would greatly reduce the sensitivity of the debt-to-GDP ratio to currency depreciations (according to dePlaa and Yi's, 2005, estimates a negative shock to the exchange rate would

(2015) conduct a quantitative analysis using a VAR model and confirm the, under a set of plausible assumptions, local currency lending would be beneficial for IDA.

Perry (2009) moves one step further and suggests that multilateral development banks should retain currency risk and that such a policy would not have negative implications for institutions that, like the World Bank, can pool currency risks over a large number of countries. With specific reference to regional development banks, an alternative would be to offload the currency risk to funds that are able to achieve global diversification. For instance, TCX (The Currency Exchange Fund) hedging would allow regional development banks to achieve the benefit of global diversification or also allow an institution like IDA to experiment with local currency lending in a limited subset of countries. Perry (2009) describes a possible swap with TCX as follows:

> TCX would accept foreign exchange exposures on transactions originated primarily by its customers (for the first three years only by its shareholders) in hard currencies, by offering swaps and forwards to convert them into domestic currencies for the beneficiaries at the same maturities. Originating customers would retain the credit risk, so that TCX would retain only the currency risk, and though it plans to diversify some away through existing derivative markets, it expects to achieve most risk diversification through its global pooling. TCX estimates that its global fund of developing country domestic currencies can achieve, on average, a 75 percent risk reduction in comparison with a single currency risk. Regional development banks and other investors would have guaranteed access for about three to four times

increase the debt-to-GDP ratio by 0.39 standard deviations under current IDA practices and by 0.07 standard deviations under the Hausmann and Rigobon proposal). However, dePlaa and Yi (2005) find no benefit (but also no cost) for IDA's portfolio diversification. While economic theory predicts that the real exchange rate od low income countries should appreciate over time (this is the Balassa-Sameulson effect), dePlaa and Yi (2005) show that over 1985-2005 the real exchange rate of IDA countries depreciated and that an inflation indexed local currency lending program would have reduced reflows by about $1 billion. It is worth noting that this is not a large amount considering that over the same period IDA replenishments amounted to more than $100 billion.

> their equity investment in TCX (some will join through deeply subordinated debt instruments). [...] Although of a modest initial size, TCX has the potential to achieve a significant impact in small- and medium-sized countries where local currency markets are small and essentially short-term. (Perry, 2009 p. 45-46)

As predicted by Perry (2009), over the ten past years TCX has indeed grown rapidly. Since inception, TCX provided currency-hedging instruments for more than 3500 private sector external lending operations and proved its business model. TCX is growing rapidly. In 2020, TCX targets to provide a total volume of about US$3 billion in exotic currency swaps and raises additional capital to increase its total swap portfolio to more than 7 billion in 2022 to act as market maker especially in the currencies issued by low-income countries.

So far, we discussed factors that limit the supply of domestic currency lending. There are, however, also factors that limits the demand for such instruments.

One obstacle to market creation relates to the fact that low-income countries tend to have limited debt management capacity. Hence, their debt managers may not fully appreciate the costs and benefits of local currency instruments with an embedded insurance component (Paesani and Piga, 2010). Alternatively, debt managers in low-income countries may be afraid to be "duped" into issuing complex and costly instruments by slick investment bankers. One policy response is to strengthen local debt management capacity, so that debt managers are better equipped in understanding and evaluating the cost/risk tradeoffs involved in different borrowing options. However, it should be pointed out that limited capacity should not be an obstacle when dealing with multilateral financial institutions which do not have a profit motive and could offer just one type (or a limited menu) of domestic currency instruments with transparent rules, possibly (like in the case of IDA), at subsidized rates.[15]

[15] Adverse selection can also be a problem. This is less of a problem with official lenders that have a cooperative nature and can offer subsidized loans in a take-it or leave offer.

Finally, there is the issue of political failures. Even in the absence of distortions, a fair currency premium would typically incorporate the incidence of a sharp devaluation in the future. This situation is analogous to buying insurance that, by its very nature, implies a premium that must be paid during good times. While a forward looking benevolent policymaker would find that the premium exactly compensates for currency risk, and, in the presence of risk aversion, would opt for the safer local currency debt, myopic policymakers who only care about the present would disregard negative events that may materialize when they are no longer in office. If, as usual, the probability of a currency adjustment increases with the time horizon, myopic policymakers would find the premium expensive relative to short-term risk, and would opt for foreign currency debt which would commands a lower interest rate but leave future governments exposed to currency risk. Again, the multilateral financial institutions could play a role in mitigating these political failures by clearly explaining to policymakers and to the public the insurance benefits of local currency debt. Therefore, disseminating debt management best practices across member countries would be a necessary condition for the development of local currency instruments.

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Table 1: Coverage of the public debt dataset

Year	Low income countries	Lower middle income countries	Upper middle income countries	Total
1970	25	24	4	53
1980	29	28	5	63
1990	35	37	4	76
2000	52	38	12	102
2010	28	44	35	107
2017	25	37	40	102

Table 2: Public debt composition in developing countries

	D/Y	E/Y	T/Y	D/T	D/Y	E/Y	T/Y	D/T
	Simple Average							
	2000				**2007**			
LIC	0.14	0.85	0.99	0.11	0.11	0.46	0.57	0.18
LMIC	0.07	0.47	0.53	0.10	0.07	0.28	0.35	0.14
UMIC	0.15	0.36	0.50	0.20	0.12	0.34	0.45	0.17
Total	0.11	0.65	0.76	0.12	0.09	0.36	0.46	0.17
	2014				**2017**			
LIC	0.11	0.27	0.38	0.26	0.17	0.34	0.50	0.30
LMIC	0.10	0.35	0.46	0.20	0.13	0.43	0.56	0.18
UMIC	0.08	0.40	0.48	0.18	0.11	0.42	0.53	0.20
Total	0.10	0.35	0.45	0.20	0.13	0.40	0.53	0.22
	Weighted Average							
	2000				**2007**			
LIC	0.20	0.46	0.67	0.33	0.10	0.22	0.33	0.33
LMIC	0.04	0.40	0.44	0.10	0.13	0.20	0.33	0.34
UMIC	0.11	0.29	0.40	0.19	0.12	0.18	0.31	0.21
Total	0.12	0.36	0.48	0.20	0.13	0.19	0.32	0.27
	2014				**2017**			
LIC	0.07	0.28	0.35	0.19	0.14	0.34	0.49	0.26
LMIC	0.16	0.24	0.40	0.38	0.20	0.25	0.45	0.40
UMIC	0.13	0.27	0.40	0.28	0.16	0.28	0.44	0.24
Total	0.14	0.26	0.40	0.31	0.17	0.27	0.44	0.31

Data for 2000 include 102 countries; data for 2007 and 2014 include 107 countries; and data for 2017 include 102 countries. D/Y is domestic public debt over GDP, E/Y is external public debt over GDP, T/Y is total public debt over GDP, D/T is domestic debt over total debt.

Table 3: Debt growth, debt composition and the exchange rate

	(1)	(2)	(3)	(4)	(5)	(6)
DEBT/GDP(t-1)	-0.086***	-0.084***	-0.085***	-0.084***	-0.086***	-0.095***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.012)
GROWTH(t-1)	-3.606	-4.143	-10.901*	-11.122*	-3.564	-16.913
	(6.390)	(6.339)	(6.596)	(6.584)	(7.660)	(13.906)
Ln(GDP PC(t-1))	0.195	0.274	0.127	0.158	0.376	0.742
	(0.297)	(0.294)	(0.303)	(0.303)	(0.459)	(1.510)
DXR(t)	24.439***	-14.907**			-14.338	-27.193
	(2.789)	(7.061)			(9.402)	(18.652)
FXD/TD (t-1)	4.808***	1.741	4.498***	2.953**	2.801	7.081*
	(1.237)	(1.327)	(1.259)	(1.361)	(1.735)	(3.706)
DXR(t)*FXD/TD (t-1)		**56.642*** **			**57.724*** **	**80.122*** **
		(9.352)			**(12.011)**	**(22.914)**
Ln(INFLATION)	-1.246***	-1.216***	0.057	0.083	-1.287***	-1.322*
	(0.310)	(0.308)	(0.313)	(0.313)	(0.397)	(0.693)
PRIM SURPLUS	-0.828***	-0.840***	-0.862***	-0.869***	-0.882***	-0.895***
	(0.053)	(0.052)	(0.054)	(0.054)	(0.064)	(0.107)
INTEREST PAYMENT	1.059***	1.051***	1.078***	1.081***	1.066***	1.077***
	(0.056)	(0.056)	(0.058)	(0.058)	(0.067)	(0.098)
DXR(t-1)			-1.817	-21.632***		
			(2.802)	(7.261)		
DXR(t)* FXD/TD (t-1)				**28.131*** **		
				(9.512)		
Constant	0.310	1.725	0.129	0.862	0.389	-3.900
	(2.902)	(2.887)	(2.956)	(2.961)	(4.001)	(10.860)
Observations	2,182	2,182	2,183	2,183	1,690	802
R-squared	0.341	0.352	0.312	0.315	0.354	0.372
Country FE	No	No	No	No	No	No
Year FE	No	No	No	No	No	No
Sample	All	All	All	All	Low and lower middle income	Low income

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 4: Debt growth, debt composition and the exchange rate, FE regressions

	(1)	(2)	(3)	(4)	(5)	(6)
DEBT/GDP(t-1)	-0.127***	-0.124***	-0.121***	-0.128***	-0.135***	-0.166***
	(0.00908)	(0.00901)	(0.00920)	(0.00738)	(0.0110)	(0.0192)
GROWTH(t-1)	-14.05**	-14.85**	-19.24***	-22.51***	-15.34*	-15.39
	(6.993)	(6.930)	(7.093)	(4.812)	(8.443)	(15.72)
Ln(GDP PC(t-1))	4.754***	5.499***	5.305***	4.945***	6.806***	4.356
	(1.189)	(1.184)	(1.219)	(0.821)	(1.572)	(3.650)
DXR(t)	21.58***	-22.05***			-21.51**	-32.61
	(3.363)	(7.740)			(10.36)	(21.43)
FXD/TD (t-1)	7.795***	4.409**	6.899***	1.662	6.558**	7.214
	(1.986)	(2.041)	(2.002)	(1.560)	(2.712)	(5.447)
DXR(t)*FXD/TD (t-1)		**61.94*** **			**62.46*** **	**87.95*** **
		(9.918)			**(12.86)**	**(25.75)**
Ln(INFLATION)	-0.847***	-0.853***	-0.842***		-0.897***	-0.999***
	(0.0610)	(0.0605)	(0.0616)		(0.0728)	(0.120)
PRIM SURPLUS	1.017***	1.016***	1.017***		1.003***	1.040***
	(0.0622)	(0.0616)	(0.0634)		(0.0713)	(0.103)
INTEREST PAYMENT	-0.113	0.0471	1.205***		0.374	0.400
	(0.423)	(0.420)	(0.419)		(0.543)	(0.968)
DXR(t-1)			-6.987**	-24.91***		
			(3.372)	(6.462)		
DXR(t)* FXD/TD (t-1)				**36.80*** **		
				(8.007)		
Constant	-34.18***	-37.68***	-38.74***	-27.60***	-46.08***	-24.73
	(9.106)	(9.040)	(9.295)	(6.095)	(11.42)	(24.01)
Observations	2,182	2,182	2,183	3,727	1,690	801
R-squared	0.415	0.426	0.399	0.204	0.434	0.466
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	Low and lower middle income	Low income

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 5: Debt explosions, debt composition and the exchange rate

	(1)	(2)	(3)	(4)
DEBT/GDP(t-1)	0.095***	0.096***	0.105***	0.123***
	(0.016)	(0.016)	(0.018)	(0.026)
GROWTH(t-1)	0.171	0.174	0.138	-0.346
	(0.146)	(0.145)	(0.164)	(0.290)
Ln(GDP PC(t-1))	0.002	0.002	0.001	0.027
	(0.006)	(0.006)	(0.009)	(0.028)
DXR(t)	0.811***	0.459***	0.556***	0.460
	(0.060)	(0.153)	(0.182)	(0.344)
FXD/TD (t-1)	0.082***	0.059**	0.064**	0.198***
	(0.025)	(0.026)	(0.032)	(0.065)
DXR(t)*FXD/TD (t-1)		**0.518****	**0.432***	**0.853***
		(0.208)	**(0.239)**	**(0.435)**
PRIM SURPLUS	-0.009***	-0.010***	-0.009***	-0.011***
	(0.001)	(0.001)	(0.002)	(0.003)
INTEREST PAYMENT	0.007***	0.007***	0.007***	0.006***
	(0.001)	(0.001)	(0.001)	(0.002)
Ln(INFLATION)	0.014**	0.014**	0.012	0.007
	(0.007)	(0.007)	(0.008)	(0.013)
Constant	-0.118**	-0.106*	-0.101	-0.341*
	(0.060)	(0.060)	(0.078)	(0.206)
Observations	1,604	1,216	506	1,604
R-squared	0.203	0.223	0.291	0.203
Country FE	No	No	No	No
Year FE	No	No	No	No
Sample	All	All	Low and lower middle income	Low income

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 6: Debt explosions, debt composition and the exchange rate, FE regressions

	(1)	(2)	(3)	(4)
DEBT/GDP(t-1)	0.057***	0.058***	0.051**	0.026
	(0.021)	(0.021)	(0.023)	(0.035)
GROWTH(t-1)	-0.120	-0.131	-0.231	-0.495
	(0.149)	(0.149)	(0.167)	(0.325)
Ln(GDP PC(t-1))	0.133***	0.138***	0.134***	0.107
	(0.026)	(0.025)	(0.031)	(0.069)
DXR(t)	0.658***	0.140	0.141	-0.082
	(0.068)	(0.150)	(0.176)	(0.378)
FXD/TD (t-1)	-0.003	-0.036	-0.044	-0.086
	(0.038)	(0.038)	(0.046)	(0.089)
DXR(t)*FXD/TD (t-1)		**0.752*** **	**0.769*** **	**1.459*** **
		(0.195)	**(0.222)**	**(0.456)**
PRIM SURPLUS	-0.009***	-0.009***	-0.008***	-0.005*
	(0.002)	(0.002)	(0.002)	(0.003)
INTEREST PAYMENT	0.008***	0.008***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.002)
Ln(INFLATION)	0.022***	0.023***	0.032***	0.035**
	(0.008)	(0.008)	(0.010)	(0.017)
Constant	-1.008***	-1.027***	-0.944***	-0.616
	(0.198)	(0.197)	(0.225)	(0.456)
Observations	1,604	1,604	1,215	500
R-squared	0.441	0.447	0.495	0.538
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sample	All	All	Low and lower middle income	Low income

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 7: Evolution of the exchange rate around debt explosions

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(XR(t-3))	-0.268***	-0.241***	-0.236***	-0.208***	-0.141*	-0.070
	(0.035)	(0.037)	(0.046)	(0.066)	(0.078)	(0.099)
Ln(XR(t-2))	-0.220***	-0.217***	-0.226***	-0.123**	-0.093	-0.086
	(0.030)	(0.035)	(0.041)	(0.057)	(0.067)	(0.087)
Ln(XR(t-1))	-0.160***	-0.160***	-0.150***	-0.066	-0.065	-0.037
	(0.027)	(0.029)	(0.038)	(0.048)	(0.061)	(0.084)
Ln(XR(t+1))	0.140***	0.154***	0.178***	0.107**	0.106*	0.132
	(0.029)	(0.033)	(0.047)	(0.047)	(0.057)	(0.080)
Ln(XR(t+2))	0.206***	0.232***	0.263***	0.184***	0.207***	0.218**
	(0.035)	(0.042)	(0.052)	(0.059)	(0.075)	(0.088)
Ln(XR(t+3))	0.277***	0.309***	0.354***	0.250***	0.288***	0.318***
	(0.041)	(0.048)	(0.069)	(0.068)	(0.084)	(0.106)
Ln(XR(t-3))*FX	-0.014	-0.044	-0.083	-0.094	-0.175*	-0.290**
	(0.045)	(0.049)	(0.062)	(0.091)	(0.104)	(0.131)
Ln(XR(t-2))*FX	-0.052	-0.065	-0.092*	-0.179**	-0.223**	-0.261**
	(0.040)	(0.044)	(0.053)	(0.078)	(0.088)	(0.111)
Ln(XR(t-1))*FX	**-0.066***	**-0.064***	**-0.110****	**-0.190*****	**-0.186****	**-0.247****
	(0.034)	**(0.037)**	**(0.047)**	**(0.066)**	**(0.081)**	**(0.104)**
Ln(XR(t+1))*FX	0.015	0.006	0.029	0.060	0.069	0.085
	(0.036)	(0.041)	(0.056)	(0.064)	(0.077)	(0.101)
Ln(XR(t+2))*FX	0.006	-0.011	0.010	0.036	0.022	0.066
	(0.042)	(0.049)	(0.060)	(0.078)	(0.096)	(0.111)
Ln(XR(t+3))*FX	-0.009	-0.033	-0.022	0.028	-0.005	0.023
	(0.048)	(0.055)	(0.076)	(0.088)	(0.105)	(0.127)
Constant	4.605***	4.605***	4.605***	4.605***	4.605***	4.605***
	(5.90e-10)	(3.52e-10)	(7.31e-10)	(5.90e-10)	(6.43e-10)	(6.43e-10)
Observations	1,325	1,114	678	1,325	1,114	678
R-squared	0.425	0.437	0.521	0.430	0.442	0.528
Sample	All	Low and lower middle income	Low income	All	Low and lower middle income	Low income
FX is	Dummy=1 when FX share at T-1>60%			Continuous value of FX share at T-1		

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 8: Inflation and debt composition

	(1)	(2)	(3)	(4)	(5)
ln(CPI)(t-1)	0.977***	0.978***	0.978***	0.979***	0.979***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
DD/TD(t-1)	0.002	-0.002	-0.012	0.205***	0.204***
	(0.008)	(0.008)	(0.012)	(0.053)	(0.058)
TD/GDP(t-1)		0.0003***	0.0002***	0.0003***	0.0003***
		(5.08e-05)	(7.47e-05)	(5.14e-05)	(7.84e-05)
DD/TD(t-1)* TD/GDP(t-1)			0.0002		1.10e-05
			(0.0002)		(0.0002)
DD/TD(t-1)*CPIA				**-0.065*** **	**-0.064*** **
				(0.016)	**(0.017)**
Constant	0.176***	0.158***	0.160***	0.153***	0.153***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
Observations	2,609	2,609	2,609	2,588	2,588
R-squared	0.998	0.998	0.998	0.998	0.998
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	All

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 9: Inflation and debt composition, all country-year with above median Chinn and Ito index

	(1)	(2)	(3)	(4)	(5)
ln(CPI)(t-1)	0.976***	0.977***	0.977***	0.978***	0.977***
	(0.00269)	(0.00272)	(0.00272)	(0.00274)	(0.00274)
DD/TD(t-1)	0.0167	0.00983	0.0121	0.106	0.121
	(0.0122)	(0.0125)	(0.0159)	(0.0805)	(0.0854)
TD/GDP(t-1)		0.0002**	0.0002*	0.0002**	0.0003*
		(8.01e-05)	(0.0001)	(8.11e-05)	(0.0001)
DD/TD(t-1)* TD/GDP(t-1)			-5.51e-05		-0.0001
			(0.0002)		(0.0002)
DD/TD(t-1)*CPIA				**-0.0295**	**-0.0324**
				(0.0242)	**(0.0248)**
Constant	0.173***	0.161***	0.160***	0.161***	0.159***
	(0.0118)	(0.0128)	(0.0134)	(0.0129)	(0.0136)
Observations	1,241	1,241	1,241	1,220	1,220
R-squared	0.998	0.998	0.998	0.998	0.998
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	All

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 10: Inflation and debt composition, all country-year with below median Chinn and Ito index

	(1)	(2)	(3)	(4)	(5)
ln(CPI)(t-1)	0.986***	0.986***	0.986***	0.989***	0.989***
	(0.00330)	(0.00327)	(0.00327)	(0.003)	(0.003)
DD/TD(t-1)	0.00792	-0.00394	-0.0130	0.329***	0.342***
	(0.0148)	(0.0149)	(0.0202)	(0.093)	(0.101)
TD/GDP(t-1)		0.0004***	0.0003***	0.0004***	0.0004***
		(8.39e-05)	(0.0001)	(8.38e-05)	(0.0001)
DD/TD(t-1)* TD/GDP(t-1)			0.0002		-8.08e-05
			(0.0003)		(0.0003)
DD/TD(t-1)*CPIA				**-0.110*** **	**-0.113*** **
				(0.0305)	**(0.0317)**
Constant	0.154***	0.134***	0.137***	0.121***	0.120***
	(0.0127)	(0.0133)	(0.0139)	(0.0136)	(0.0147)
Observations	1,178	1,178	1,178	1,178	1,178
R-squared	0.998	0.998	0.998	0.998	0.998
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	All

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 11: Inflation and debt composition, all country-year with above median credit to the private sector

	(1)	(2)	(3)	(4)	(5)
ln(CPI)(t-1)	0.970***	0.972***	0.973***	0.974***	0.974***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
DD/TD(t-1)	0.0198**	0.0166*	0.0102	0.189**	0.186**
	(0.0097)	(0.009)	(0.0146)	(0.0750)	(0.0806)
TD/GDP(t-1)		0.0002***	0.0002*	0.0002***	0.0002**
		(7.23e-05)	(9.75e-05)	(7.32e-05)	(0.000101)
DD/TD(t-1)* TD/GDP(t-1)			0.0001		2.11e-05
			(0.0002)		(0.0002)
DD/TD(t-1)*CPIA				**-0.0508** **	**-0.0504** **
				(0.0219)	**(0.0225)**
Constant	0.187***	0.170***	0.170***	0.163***	0.163***
	(0.0151)	(0.0162)	(0.0162)	(0.0164)	(0.0165)
Observations	1,422	1,422	1,422	1,401	1,401
R-squared	0.997	0.997	0.997	0.997	0.997
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	All

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 12: Inflation and debt composition, all country-year with above median credit to the private sector

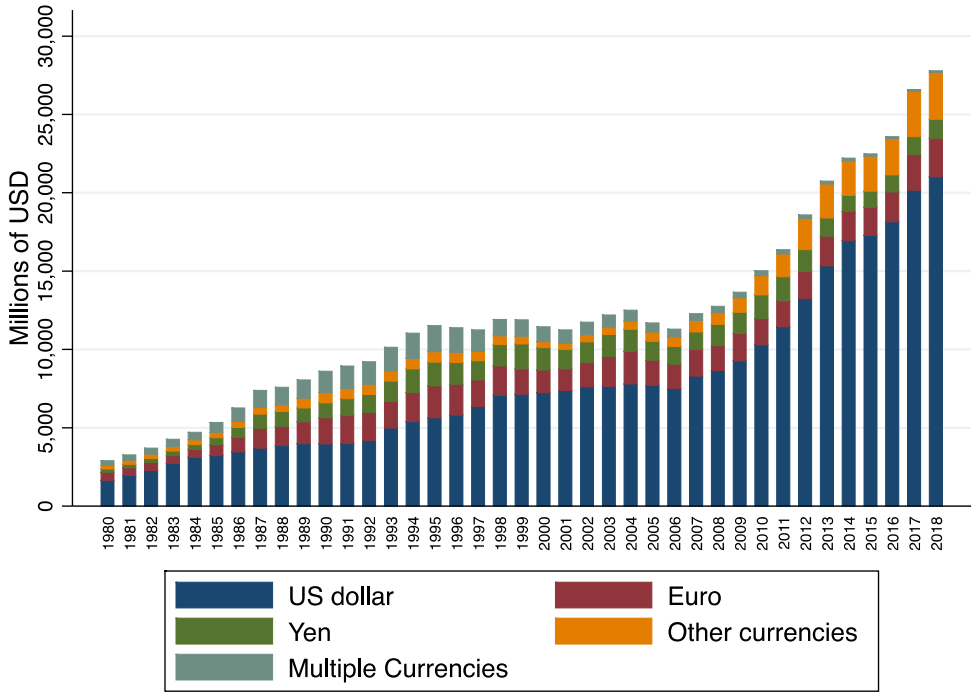
	(1)	(2)	(3)	(4)	(5)
ln(CPI)(t-1)	0.986***	0.986***	0.986***	0.989***	0.989***
	(0.00330)	(0.00327)	(0.00327)	(0.00333)	(0.00334)
DD/TD(t-1)	0.00792	-0.00394	-0.0130	0.329***	0.342***
	(0.0148)	(0.0149)	(0.0202)	(0.0933)	(0.101)
TD/GDP(t-1)		0.000381***	0.000321***	0.000412***	0.000442***
		(8.39e-05)	(0.000124)	(8.38e-05)	(0.000128)
DD/TD(t-1)* TD/GDP(t-1)			0.000166		-8.08e-05
			(0.000250)		(0.000258)
DD/TD(t-1)*CPIA				**-0.110*** **	**-0.113*** **
				(0.0305)	**(0.0317)**
Constant	0.154***	0.134***	0.137***	0.121***	0.120***
	(0.0127)	(0.0133)	(0.0139)	(0.0136)	(0.0147)
Observations	1,178	1,178	1,178	1,178	1,178
R-squared	0.998	0.998	0.998	0.998	0.998
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	All

Standard errors in parenthesis; *** statistically significant at 1%; ** statistically significant at 5%; and * statistically significant at 10%.

Table 13: Granger causality tests (based on a bivariate VAR with 4 lags)

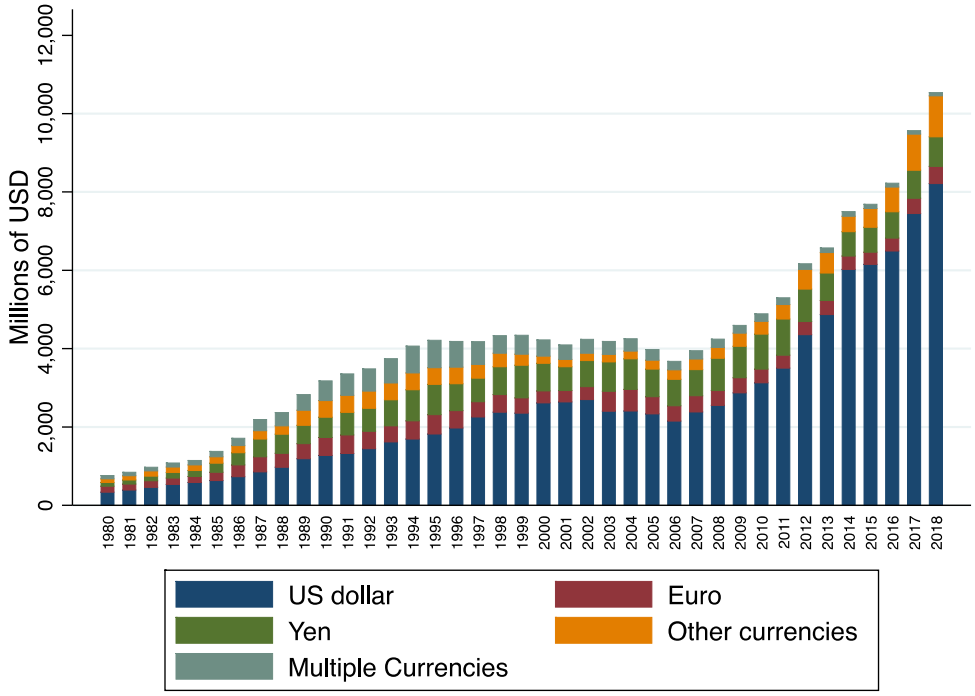
Equation	Excluded	chi2	df	Prob > chi2
All countries				
DD/TD	Ln(CPI)	55.566	4	0.000
Ln(CPI)	TD/DD	14.331	4	0.006
Low-income countries				
DD/TD	Ln(CPI)	**27.269**	4	0.000
Ln(CPI)	TD/DD	**4.0112**	4	0.404
Lower-middle income countries				
DD/TD	Ln(CPI)	35.264	4	0.000
Ln(CPI)	TD/DD	15.503	4	0.004
Low and lower-middle income countries				
DD/TD	Ln(CPI)	58.408	4	0.000
Ln(CPI)	TD/DD	12.019	4	0.017

Figure 1A: Currency composition of PPG external debt in developing economies



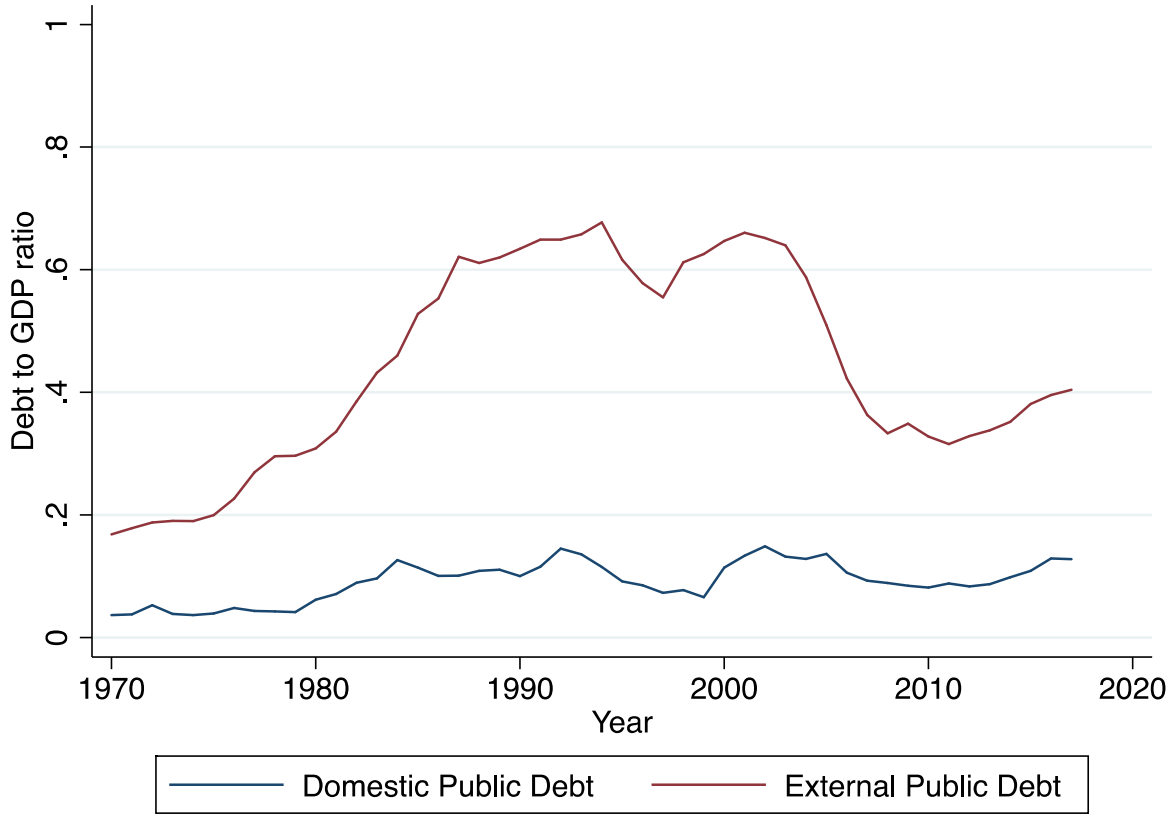
Source: own calculations based on Word Bank Data (International Debt Statistics)

Figure 1B: Currency composition of PPG external debt in low-income economies



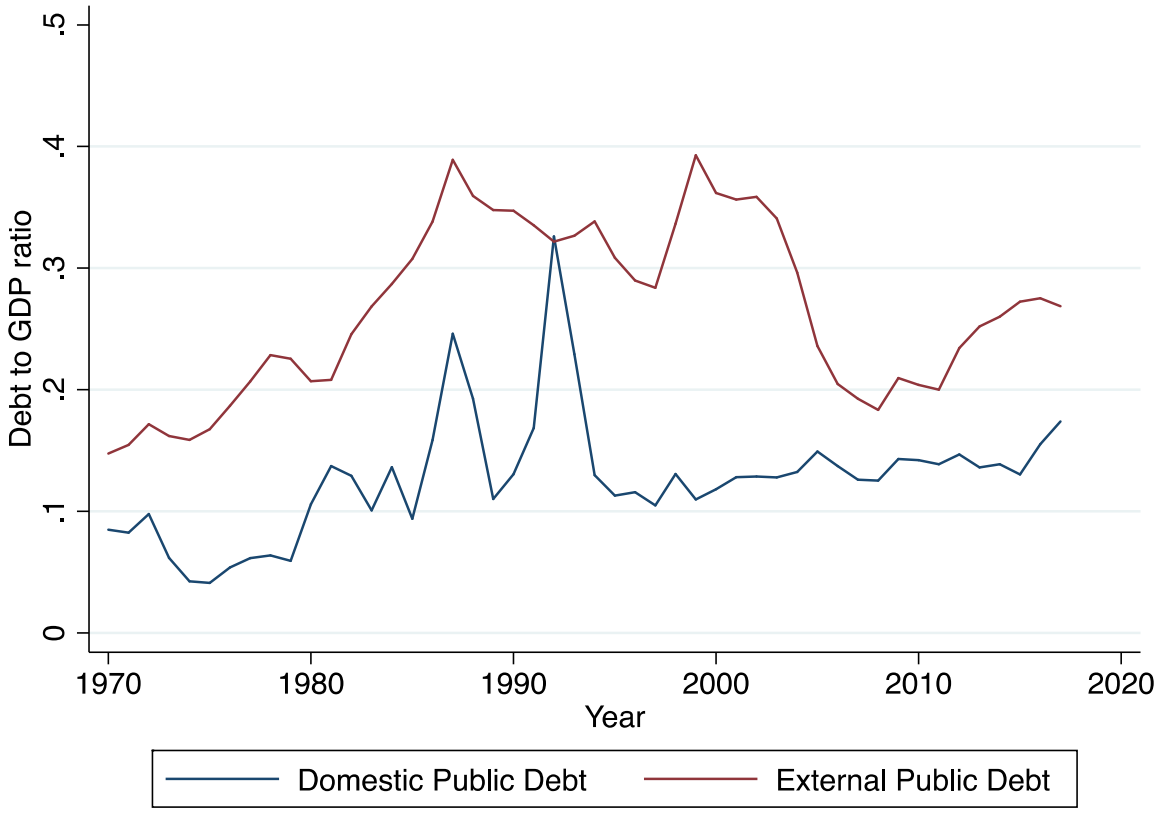
The sample is composed of countries that were classified by the World Bank as Low-Income Economies in 1987.
Source: own calculations based on Word Bank Data (International Debt Statistics)

Figure 2: Domestic and external public debt as a share of GDP (simple average)



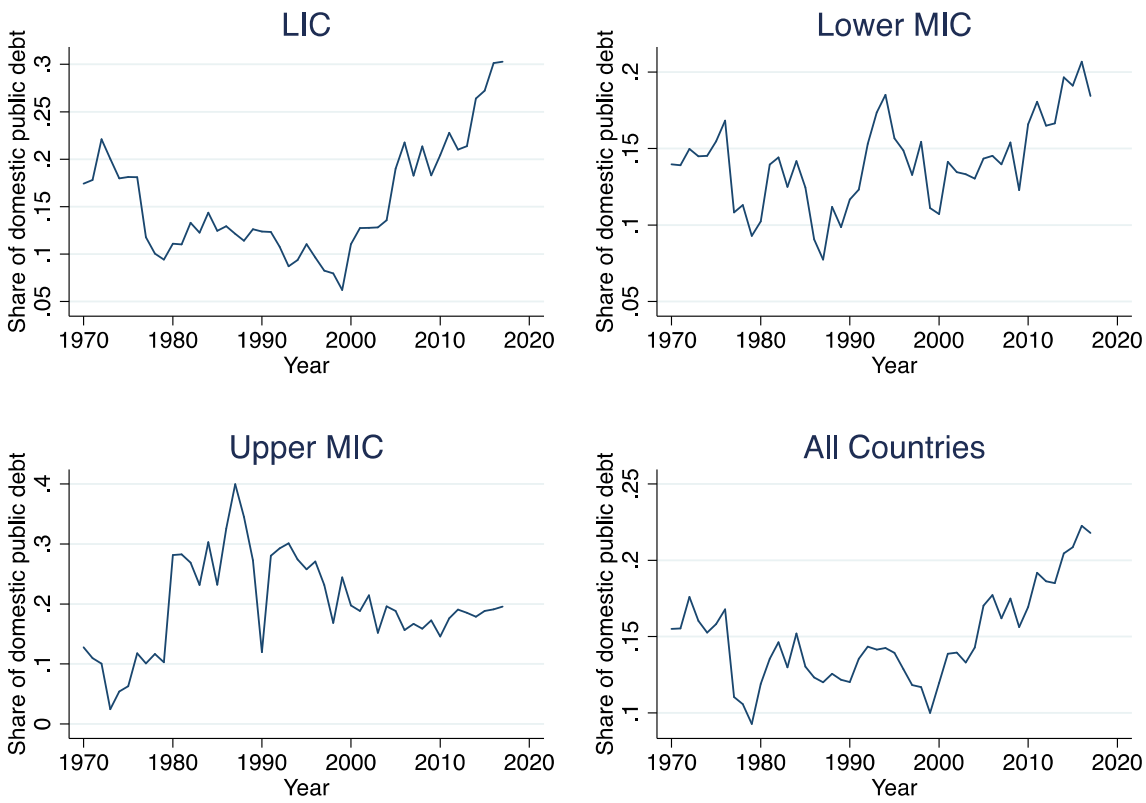
Source: own calculations based on Word Bank (International Debt Statistics) and Abbas et al. data

Figure 3: Domestic and external public debt as a share of GDP (weighted average)



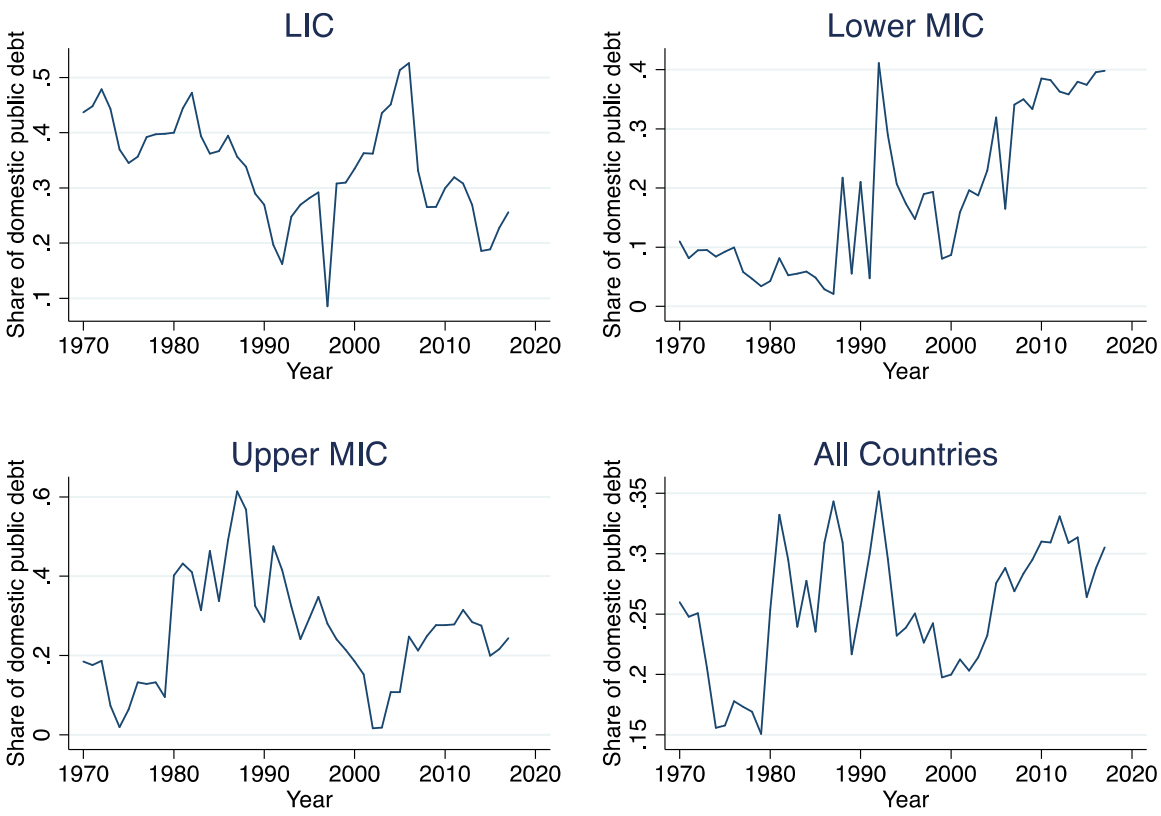
Source: own calculations based on Word Bank (International Debt Statistics) and Abbas et al. data

Figure 4: Share of domestic public debt over total public debt (simple average)



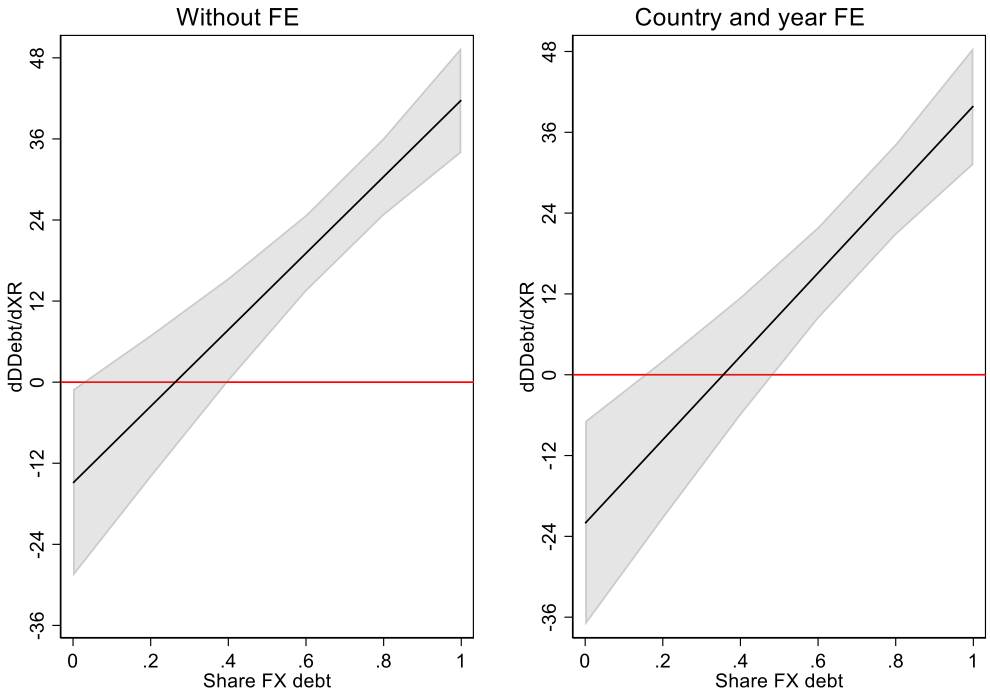
Source: own calculations based on Word Bank (International Debt Statistics) and Abbas et al. data

Figure 5: Share of domestic public debt over total public debt (weighted average)



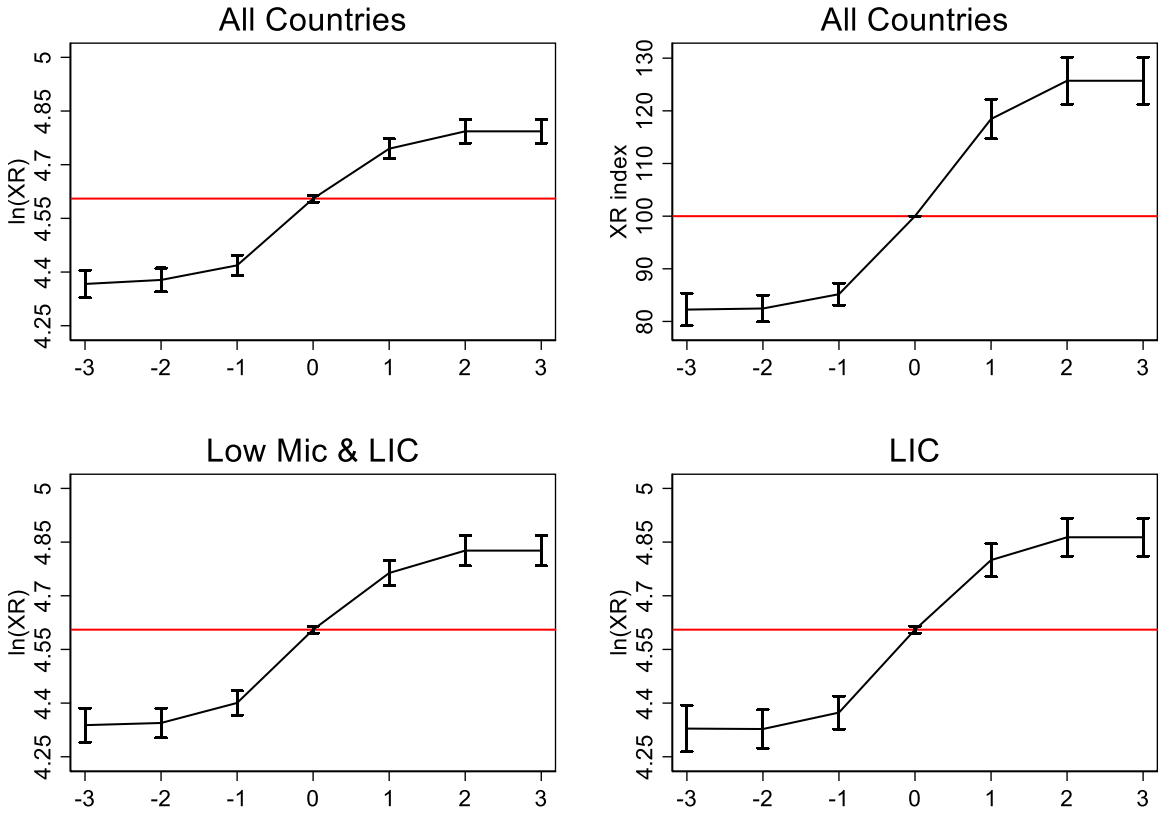
Source: own calculations based on Word Bank (International Debt Statistics) and Abbas et al. data

Figure 6: The Relationship between debt growth and the exchange rate at different levels of foreign currency debt



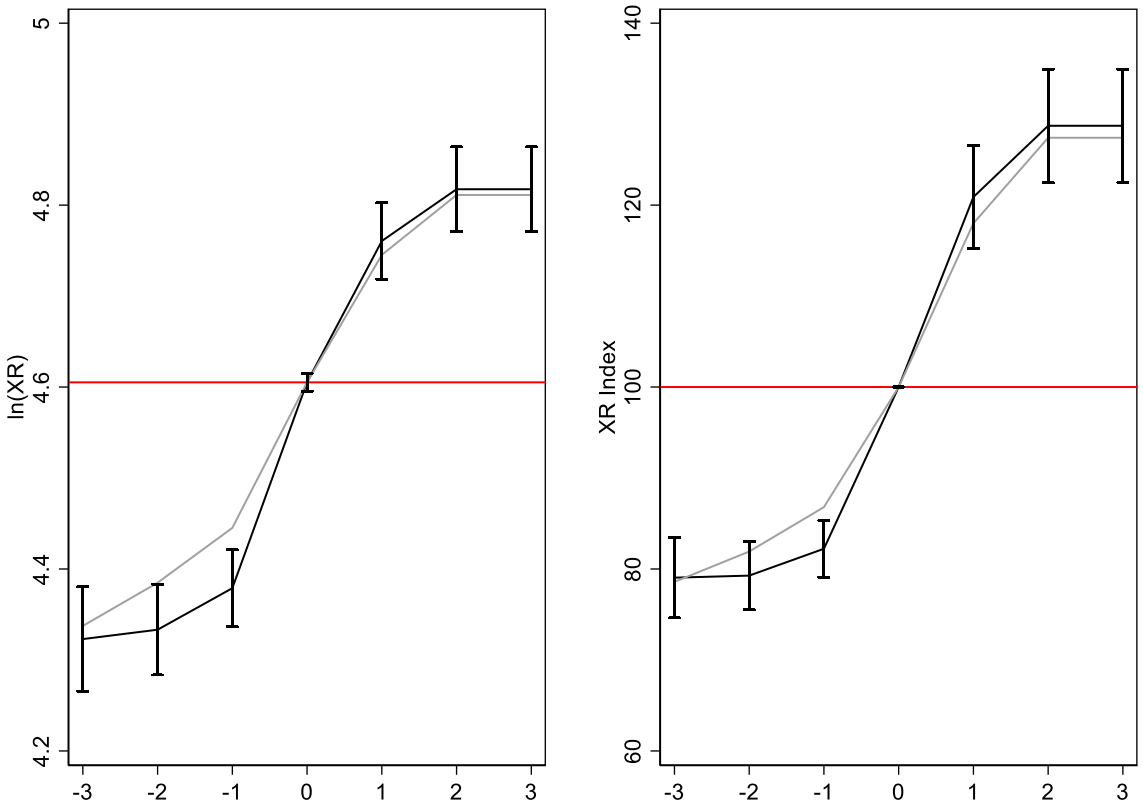
Source: the left panel is based on column 2 of Table 3 and the right panel is based on column 2 of Table 4.

Figure 7: Behavior of the nominal exchange rate around debt explosions



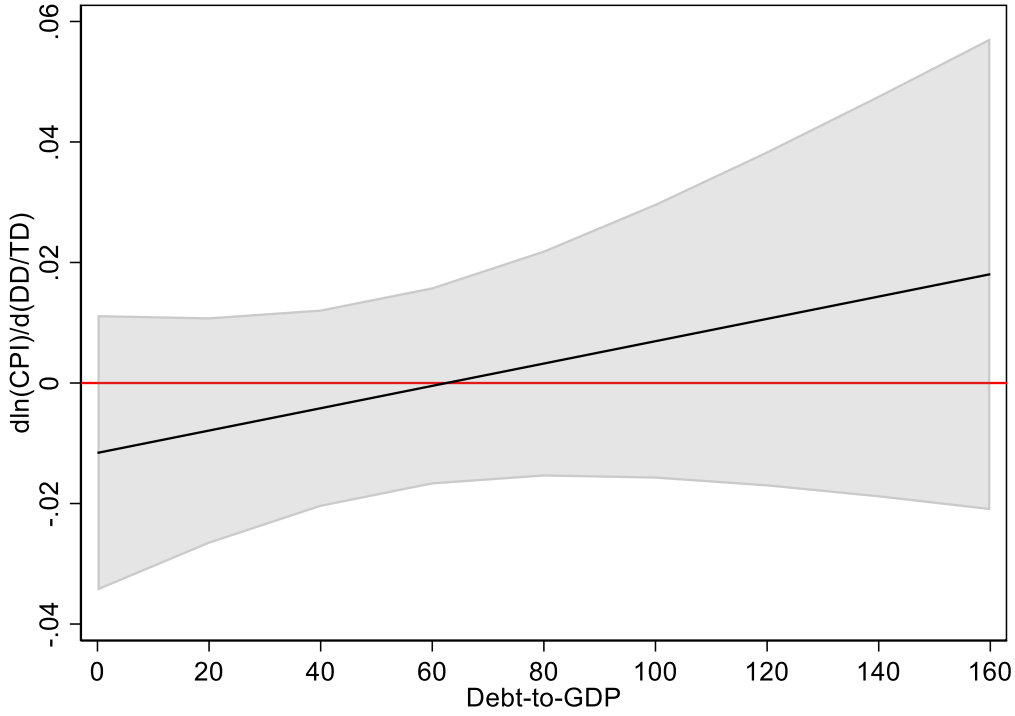
The exchange rate is expressed as an index taking value 100 at T=0. The top right panel plots the index around debt explosions and the other three panels plot the log of the index around debt explosions. The spikes are 95% confidence intervals and the red line plots the value of the index (or the log of the index) at T=0.

Figure 8: Behavior of the nominal exchange rate around debt explosions, countries with high and low values of foreign debt



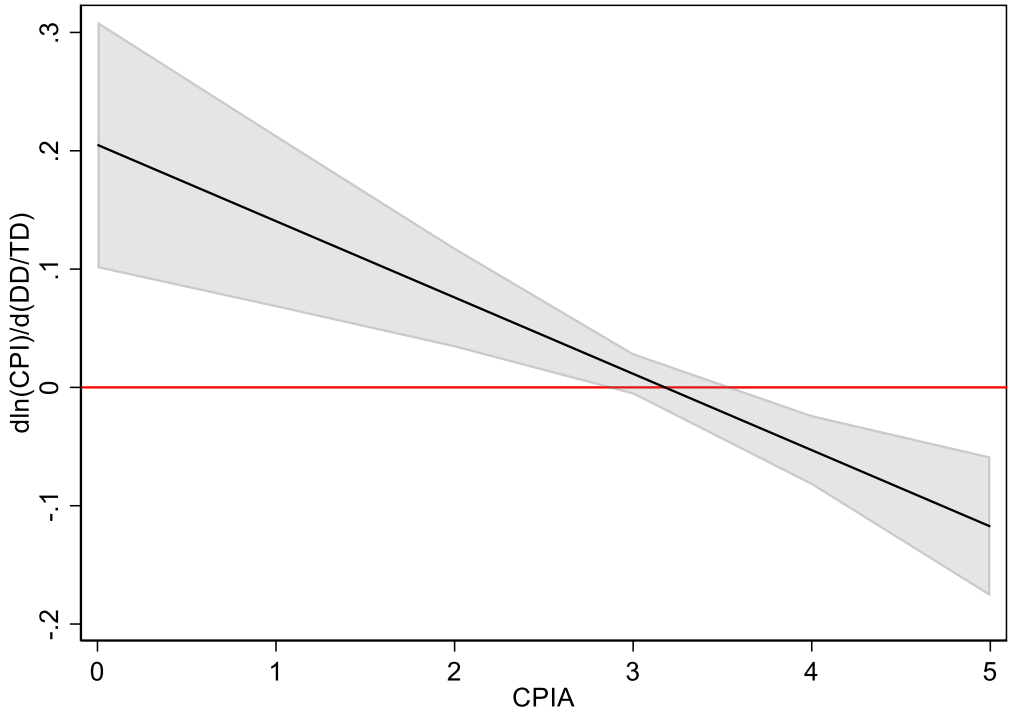
The black lines plot the exchange rate index (in logs in the left panel and in level in the right panel) around debt explosions for countries with a high share of foreign public debt (defined as more than 60% of total public debt at T-1) and the grey lines plot the behavior of the exchange rate in countries where less than 60% of public debt is external. The spikes are 95% confidence intervals and the red line plots the value of the index (or the log of the index) at T=0.

Figure 9: Correlation between share of domestic debt and CPI inflation at different levels of public debt



Source: own calculations based on the regression of column 3 in Table 8.

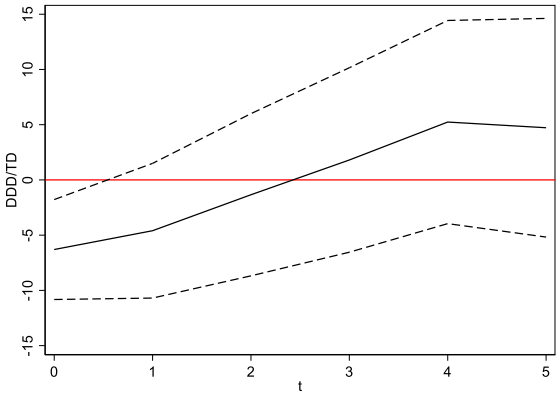
Figure 9: Correlation between share of domestic debt and CPI inflation at different levels of the CPIA index



Source: own calculations based on the regression of column 4 in Table 8.

Figure10: Local projections results

Response of the share of domestic debt to ln(CPI)



Response of ln(CPI) to the share of domestic debt

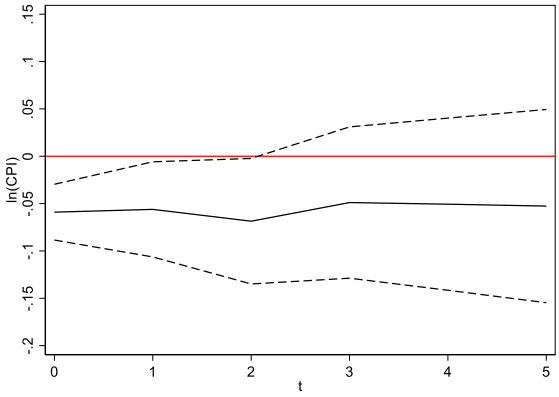
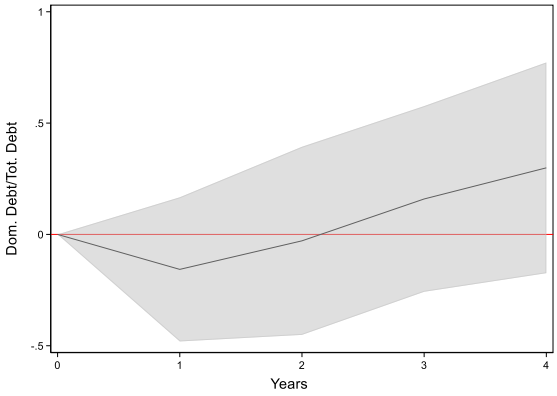


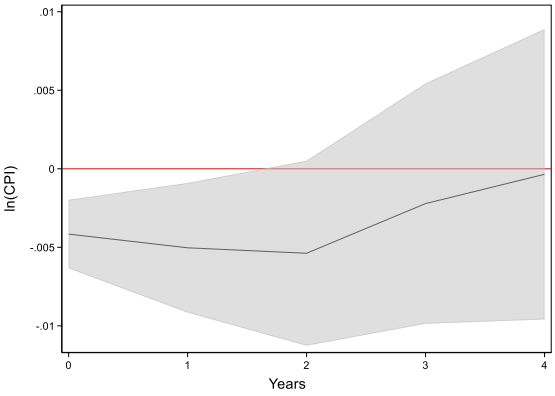
Figure11: Impulse response functions

Debt composition ordered first

Response of the share of domestic debt to ln(CPI)

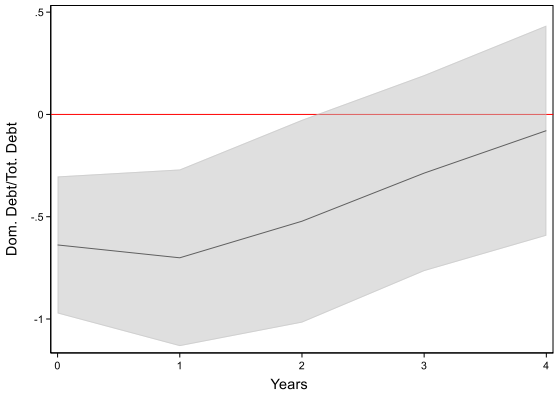


Response of ln(CPI) to the share of domestic debt

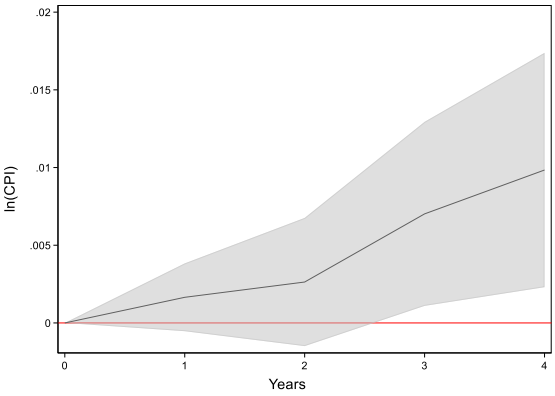


ln(CPI) ordered first

Response of the share of domestic debt to ln(CPI)



Response of ln(CPI) to the share of domestic debt



Appendix

Table A1: Data description and sources

DEBT GROWTH	First difference of the debt-to-GDP ratio. Source: IMF Global Debt Database.
DEBT/GDP	Central Government Debt over GDP. Source: IMF Global Debt Database.
GDP GROWTH	Real GDP growth. Source: World Development Indicator.
GDP PC	GDP per capita in log. Source: World Development Indicator.
GDP	Total GDP in log. Source: World Development Indicator.
DXR	Log of the ratio between the exchange rate at time t and time (t-1).
FXD/TD	Share of external debt over total debt. Source: World Development Indicator and IMF Global Debt Database.
INFLATION	Log of 1+ Inflation, consumer prices (annual %). Source: World Development Indicator.
PRIMARY BALANCE	General government primary net lending/borrowing. Source: IMF WEO.
INTEREST PAYMENT	Real expenditure on interest payment for government debt. Defined as the real interest rate (nominal interest rate minus real growth) times the stock of government debt. Source: IMF WEO and World Development Indicator.
DD/TD	Share of domestic debt over total debt. It is the complementary share of FXD/TD. Source: World Development Indicator and IMF Global Debt Database.
DE	Dummy that takes value 1 in years of Debt Explosions and 0 in other years. Debt explosions are events in which the debt to GDP ratio increases by at least 10 percentage points (the top 10% of the distribution of debt growth).
FX	It is used either as a dummy variable taking value 1 if the share of Foreign Currency debt is greater than 60% or as a continuous variable.
CPIA	World Bank index of Country Policy and institutional Assessment. Index ranges from 1 (weak institutions) to 6 (very high-quality institutions).

Table A2: Comparison with Arslanalp and Tsuda (2014)

This table compares the domestic debt shares for the 13 countries covered in both the Panizza and Taddei and Arslanalp and Tsuda datasets (simple averages)

	Mean	Median	St. Dev.	P25	P75	Min	Max	N.Obs
	Share of domestic currency debt (%)							
Panizza and Taddei	59.3	55.7	19.6	45.05	76.25	5.0	94	156
Arslanalp and Tsuda	72.6	76.35	22.2	59.9	91.44	8.7	100	156
	Arslanalp and Tsuda - Panizza and Taddei							
AT-PT	13.2	12.3	20.8	-2.0	21.3	-33.9	66.9	156

Table A3: Comparison with Arslanalp and Tsuda (2014) by countries and years

This table compares the domestic debt shares for the 13 countries covered in both the Panizza and Taddei and Arslanalp and Tsuda datasets. The columns report the difference between the domestic debt share in Arslanalp and Tsuda and that Panizza and Taddei. They show that in Bulgaria, Brazil, and Peru, our data report higher domestic debt shares than the Arslanalp and Tsuda data and that the opposite is true for the other 10 countries included in both datasets (see also Figure A1 below). The differences are particularly large in Colombia, Indonesia, Mexico, Russia and Thailand.

Country	Mean	St. Dev	N. Obs	Year	Mean	St. Dev	N. Obs
BGR	-16.6	3.8	12	2004	16.9	19.8	9
BRA	-14.2	3.4	12	2005	16.0	21.3	9
COL	25.3	11.3	14	2006	9.7	19.2	10
IDN	40.6	7.3	14	2007	11.9	19.6	11
IND	13.7	2.0	14	2008	6.2	22.8	11
MEX	50.2	10.0	14	2009	10.6	21.1	11
PER	-4.2	3.5	13	2010	11.3	19.5	11
ROU	6.8	3.1	7	2011	10.7	19.7	12
RUS	27.0	20.2	3	2012	15.2	20.3	12
THA	17.9	3.8	14	2013	13.7	19.3	12
TUR	12.1	9.2	14	2014	15.6	23.6	13
UKR	1.8	13.7	11	2015	15.3	22.7	12
ZAF	7.6	6.6	14	2016	14.9	24.7	12
				2017	17.5	25.2	11
All	**13.2**	**20.8**	**156**		**13.2**	**20.8**	**156**

Table A4: Comparison between Arslanalp and Tsuda and World Bank Data

Column 1 reports data for total public and publicly guaranteed (PPG) bonds from the World Bank International Debt Statistics (IDS), column 2 reports data for total central government securities held by non-residents from Arslanalp and Tsuda (AT). Column 3 is the ratio between AT and IDS data. Column 4 reports the maximum amount of local currency bonds calculated from IDS. This assume that all "other currency" category is local currency and that all of this other currency category is allocated to government bonds. Column 5 reports data on non-resident holding of local currency securities from AT. Column 6 is the ration between columns 5 and 4. The last columns report local currency shares computed from the other columns. All data refer to 2018.

	Total (billion USD)			Local Currency Billion (USD)			Share in Local Currency		
	WB	AT	AT/WB	WB	AT	AT/WB	WB	AT	AT/WB
Bulgaria	8.3	3.4	0.4	0.0	0.0	974.2	0.00%	0.64%	2379.4
Brazil	42.0	150.0	3.6	1.1	114.5	103.9	2.62%	76.32%	29.1
Colombia	42.2	59.7	1.4	1.2	28.0	22.7	2.92%	46.86%	16.0
Egypt, Arab Rep.	15.8	24.9	1.6	7.8	10.8	1.4	49.64%	43.50%	0.9
Indonesia	153.5	130.2	0.8	21.8	62.7	2.9	14.17%	48.18%	3.4
India	73.8	31.0	0.4	0.6	31.0	53.9	0.78%	99.81%	128.1
Mexico	237.2	172.8	0.7	94.4	110.7	1.2	39.79%	64.03%	1.6
Peru	13.7	24.3	1.8	0.1	13.6	113.3	0.88%	56.17%	64.0
Philippines	15.8	22.4	1.4	0.5	6.7	15.0	2.86%	30.18%	10.6
Romania	27.3	29.4	1.1	0.2	7.8	39.9	0.71%	26.45%	37.2
Russian Federation	53.5	47.2	0.9	0.2	28.6	130.0	0.41%	60.48%	147.3
Thailand	30.5	28.4	0.9	0.0	27.2	5020.9	0.02%	95.59%	5384.9
Turkey	77.4	69.1	0.9	0.3	17.0	48.8	0.45%	24.64%	54.7
Ukraine	22.5	23.3	1.0	0.3	0.2	0.8	1.31%	1.00%	0.8
South Africa	70.6	81.7	1.2	46.3	60.0	1.3	65.54%	73.43%	1.1
Total	**884.1**	**897.9**	**1.0**	**174.8**	**518.9**	**3.0**	**19.77%**	**57.79%**	**2.9**

Figure A1: Comparison between domestic debt shares in Panizza and Taddei and Arslanalp and Tsuda.

The horizontal axis plots domestic debt shares from Arslanalp and Tsuda and the vertical axis plots domestic debt shares from Panizza and Taddei. Values above the 45 degrees line indicate country-years for which Panizza and Taddei report higher domestic debt shares (30% of observations) and values below the 45 degrees line report observations for which Panizza and Taddei report lower domestic debt shares.