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Debt Erosion: Asymmetric Response to Demand and Supply Shocks*

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Abstract

This paper explores the effect of inflation supply and demand shocks on government debt. It identifies the shocks using a sign-restricted Structural Vector Autoregression (SVAR) model with quarterly data. Estimations of dynamic panel regressions and local projections suggest that supply shocks lead to persistent increases in government debt, while demand shocks result in long-lasting declines. Furthermore, high debt levels increase economic vulnerability, amplifying the impacts of both supply and demand shocks by more than three times. Specifically, supply shocks increase debt through higher borrowing costs and more prolonged depreciation, whereas demand shocks erode debt through persistent reductions in primary balance, driven by increased revenues.

JEL Codes: C33, E31, G15, H63

Keywords: debt, inflation, sovereign risk, SVAR, local projections

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1. Introduction

During the COVID-19 pandemic, the world experienced a significant surge in debt levels due to the need for resources to address the health emergency. In 2020, the average advanced economy faced a 12-percentage-point (pp) increase in debt-to-GDP ratio, while debt-to-GDP ratio grew on average 19 pp in Latin American and the Caribbean (LAC) countries, and 10 pp in other emerging markets. As the pandemic was ending and restrictions began to ease, global economic activity rebounded rapidly. However, the overheating in the economies due to fiscal measures implemented during the pandemic as well as other shocks, such as the Ukraine-Russia war, has generated substantial inflationary pressures worldwide. This phenomenon is not limited to emerging markets and LAC, where inflation exceeded 15 percent, but is also observed in advanced economies, where inflation reached the highest average levels in at least the last 25 years.[5]

Governments are concerned about the sustainability of their debt levels, as the pandemic-induced debt is historically high. To address this problem, most countries have been discussing consolidation plans to improve public finances and increase market confidence. According to a debt decomposition framework, potential mechanisms for reducing debt levels include fostering economic growth, implementing austere fiscal policies, higher inflation, and currency depreciations, or, in extreme cases such as defaults, following a restructuring process. It's an open question which of the above factors contributes the most in decreasing the debt level in advanced and emerging countries.

Recent evidence shows that growth and fiscal adjustments have been successful in reducing debt, while debt restructuring processes are costly in terms of resolution time and tend to result in lower economic growth, often associated with declines in public and private investment (Asonuma and Trebesch, 2016). Furthermore, episodes of moderate inflation, coupled with robust central banks and anchored inflation expectations, have also contributed to debt reduction in emerging economies (Powell and Valencia, 2023).

[5] Data from IMF (2023b) and authors' calculations.

Given the unusually high inflation rates observed worldwide, governments may be tempted to rely on inflation to reduce indebtedness levels. However, it is crucial to recognize that not all inflationary pressures are equal, and depending on their nature the effect on debt may be the opposite of what is expected. Increases in inflation rates can be attributed to demand or supply shocks. First, demand shocks are closely linked to GDP growth. The post-pandemic rebound as well as the substantial fiscal stimulus implemented by governments globally has driven up prices due to heightened demand. On the other hand, supply shocks tend to arise in challenging times. Factors such as the Ukraine-Russian war, along with crises involving semiconductors and containers, have contributed significantly to the overall price increase.

This paper identifies the impacts of the supply and demand shocks that contribute to explaining the inflation dynamics on public debt and finds asymmetric responses of each type of shock. Supply shocks tend to have a persistent increasing effect on government debt through higher government borrowing costs as well as sustained currency depreciations. On the other hand, demand shocks contribute to a gradual decrease of government debt by improving fiscal balances, primarily driven by increases in fiscal revenues. Our results suggest that the effects of the supply and demand shocks are stronger for emerging markets than for advanced economies. Moreover, we find evidence that high levels of debt heighten the overall effect, leading to a stronger response to both supply and demand shocks, compared to countries with low debt levels.

The paper is organized as follows. Section 2 provides a comprehensive literature review. Section 3 delves into the empirical approaches used to identify supply and demand shocks and estimate their impact on public debt. The results are presented in Section 4, where we highlight the findings of our analysis. Section 5 explores the possible mechanisms of transmission of the estimated effect. Section 6 focuses on the persistence of the effects that shocks may have on debt. Section 7 discusses additional robustness checks conducted to ensure the reliability and validity of our results. Finally, in Section 8, we draw conclusions based on the overall analysis, summarizing the key findings and discussing their implications for policymakers and future research directions.

2. Related Literature

The behavior of public debt and fiscal balances follows a clear reasoning that derives from the government's budgetary constraint (Escolano, 2010). It establishes that a higher-than-expected inflation rate can decrease the value of debt; this is commonly known as debt dilution. This finding has been supported by investigations that have found empirical evidence of debt dilution. Among them, Aizenman and Marion (2011) show that when economic growth is stalled in the U.S. economy, an increase in inflation of about 5 percent for several years could significantly reduce the debt ratio. With more econometric approximations, Bon (2015) and Cherif and Hasanov (2018) estimate a significant and negative impact of inflation on public debt. And more recently, Hall and Sargent (2022) found that sharp increases in inflation were the main contributors to the reduction in debt as a percentage of GDP after World Wars I and II, which are similar shocks to the COVID-19 pandemic.

More recently, the International Monetary Fund (IMF, 2023a) summarizes the channels in which inflation can affect fiscal aggregates and indicates that the main direct channels are (i) higher nominal output lowering debt and deficits as a share of GDP, (ii) government expenditure initially failing to keep up, and (iii) the larger the debt, the greater the potential erosion from inflation. How large the inflation surge is and how long it lasts will determine which of these channels predominates. The evidence presented by IMF (2023a) highlights the pattern that inflationary surprises are historically associated with an initial rise in fiscal balances in the short term and a fall in public debt that often persists into the medium term. However, expected inflation is not associated with a fall in debt ratios, stressing that inflating debt away is neither a desirable nor a sustainable strategy. This paper presents evidence that supports the same conclusion but makes a case for identifying the asymmetric effect that inflation has depending on whether the inflation surge was caused by a demand or supply shock.

However, an analysis based on the standard debt dynamic equation disregards the importance of other factors in inflation dynamics and its causes that might change its impact on public debt. Although there has not been extensive research on other factors of the effect of inflation on debt, some research finds that inflation by itself can

not dilute the real value of debt. For instance, Davig, Leeper, and Walker (2011) state that with a passive monetary policy, a burst of inflation devalues the existing nominal debt stock. Hilscher, Raviv, and Reis (2022) show that for the United States inflation does not lower the fiscal burden significantly even if the inflation rate is high. Only when it is combined with financial repression is there a significant reduction on debt.

Powell and Valencia (2023) find that central bank independence is relevant for the dilution of debt. If inflationary expectations are well anchored, temporary increases in inflation can help reduce the debt-to-GDP ratio without leading to high nominal interest rates. Nonetheless, if inflation expectations are un-anchored, inflation rates will no longer be effective in reducing the debt levels. How the underlying cause of the inflation shocks determines the impact that inflation has on a country's debt levels has not yet been studied. This paper tries to fill that void and explore the differencing effects that higher inflation rates—due to either demand or supply factors—may have on government debt.

Inflation may not necessarily reduce debt levels; on the contrary, it may generate upward pressures by increasing the risk of default by raising the interest rates faced by the government. For example, Hur, Kondo, and Perri (2018) show that in good times, when default is unlikely, procyclical inflation yields lower real rates. In bad times, as default becomes more material, procyclical inflation can magnify default risk and trigger an increase in real rates. Remolona, Scatigna, and Wu (2008) find that inflation has a significant and positive influence in sovereign risk and risk premia in emerging markets.

In the present context, there is both a demand and a supply shock. On the supply side, the current inflation surge is being affected by the following:

- Supply chain bottlenecks: In the early days of the pandemic, the severe lockdowns in some countries around the world led to disruptions in supply chains. Then, with the fast recovery of demand experienced after lockdowns were eased, supply has not been able to catch up on delivery times.
- Disruption in the energy and food markets given the invasion of Ukraine by Russia: The Russian invasion of Ukraine in late February 2022 has led to an increase in food and energy prices, which translates into higher inflation. Both

countries are major exporters of both commodities; hence, the disruptions caused by the sanctions imposed on Russia by the West as well as the impossibility of moving goods out of Ukraine have led to disruptions worldwide.

On the demand side, the current inflation surge is being affected by the following:

- Labor supply shock: During the Great Lockdown economies experienced widespread layoffs and, after more than two years, labor supply had not returned to its pre-pandemic levels. Domash and Summers (2022) suggest that open vacancies will continue to contribute to inflationary pressures.
- Aggregate stimulus and the post-pandemic recovery: During the pandemic, governments increased fiscal stimulus to ease the effects of widespread lockdowns (IMF, 2020). The strong recovery of demand, fueled by the fiscal stimulus combined with the ease of monetary conditions during 2020, has led to increases in inflation.
- A shift in demand toward goods: During the pandemic, expenditures on goods increased. For example, there was an increase in the demand for goods that allow people to work from home and a decrease in demand for services. The proportion of consumption of goods and services has not fully gone back to pre-pandemic levels. A large part of the surge in inflation has been driven by higher prices in durable goods (i.e., used cars, household furniture), while the prices of services have not risen that much.

3. Identifying the Supply and Demand Shocks and Their Effect on Debt

This methodological section presents an approach that combines a sign-restricted Structural Vector Autoregression (SVAR) model with an Arellano-Bond dynamic panel regression to analyze the potential asymmetric effects of inflationary demand and supply shocks on debt. Employing the sign-restricted SVAR model incorporates economic theory-based constraints into the estimated impulse response functions (IRFs), allowing us to identify demand and supply shocks on both output and inflation. The Arellano-Bond dynamic panel regression is then used to assess the shocks' impact on the debt. This technique considers the presence of unobserved heterogeneity and

endogeneity, which in turn provides more reliable estimates of the shock effects on debt.

3.1. Sign-Restricted Structural VAR

Consider a SVAR model with P lags, generating a vector $Y_t = \begin{pmatrix} \text{Output}_t \\ \text{Inflation}_t \end{pmatrix}$. This model captures the relationship between Output, representing the log real GDP seasonally adjusted, and Inflation, denoting the annual change in the CPI index. The equation is given by:

$$Y_t = \sum_{p=1}^{P} A_p \, Y_{\{t-p\}} + \eta_t \qquad , \ \eta_t \sim (0, \Omega) \tag{1}$$

Where A_p represents coefficient matrices of size 2x2. The structural shocks ε_t are derived from the reduced form innovation η_t through a linear transformation, defined as:

$$\varepsilon_t = B\eta_t \tag{2}$$

Here, B is a 2x2 matrix of structural parameters ensuring that ε_t follows an identity covariance matrix $\varepsilon_t \sim (0, I_2)$. The reduced form residual covariance matrix is decomposed as $E(\eta_t \eta_t') = \Sigma_\eta = BB'$. The $\{ij\}$th element of B represents the impact response of variable i to structural shock j. Since B contains n^2 unknown elements, identifying it requires at least $n(n-1)/2$ restrictions. Our approach adopts sign restrictions to identify B, which impose weak prior beliefs based on economic theory.

The sign-restricted SVAR is applied individually to 55 countries (32 advanced economies and 23 emerging market economies).[6] The analysis employs quarterly data from the IMF's International Financial Statistics, covering the period 1970 to 2022. It is worth noting that most countries in the sample have data available from the mid-1990s onwards.

[6] See Table A1 in the Appendix for a detailed list of the countries used in the estimations. The MATLAB Toolbox developed by Breitenlechner, Geiger, and Sindermann (2018) was used to estimate the sign-restricted SVAR.

3.2. Identifying Assumptions

For the sign-restricted SVAR it is assumed that supply and demand shocks increase inflation while output moves in different directions (increasing with demand shock and decreasing with supply shock), as summarized in Table 1.

Table 1. Sign Restrictions for Impact Responses

	Demand Shock	Supply Shock
Output	+	-
Inflation	+	+

Supply shocks typically result in a decrease or restriction in output to accommodate decreased demand. On the other hand, demand shocks lead to a rise in aggregate demand, which in turn increases output (see Domash and Summers, 2022; IMF, 2020). Consequently, demand shocks cause output and prices to move in the same direction, while supply shocks cause output and prices to move in opposite directions.

Given the divergent impact of supply and demand shocks on output and their consistent effect on inflation rates, it is likely that their influence on financing costs differs as well. Recently, central banks worldwide have responded to high inflation rates by tightening monetary policy, which directly translates into increases in financing costs for governments. The expectations of investors regarding government debt are affected by whether monetary policy can effectively control inflation rates or if high inflation rates are anticipated. If inflation rates are expected to remain elevated in the coming years, investors, concerned about the potential dilution of debt, will demand higher rates from the government to finance government expenditures. As Kose et al. (2021) indicate, high levels of debt are anticipated to persist in the coming years, with expenditures being financed through debt, making financing costs a relevant concern for countries globally.

Understanding whether inflation rates are expected to be transitory or permanent is crucial for assessing the sustainability of debt in economies. Lansing (2022) demonstrates evidence for the United States suggesting that shocks tend to be more persistent than transitory, indicating that investor expectations may become

unhinged and higher rates will be demanded for government debt. Consequently, longer and more robust policy responses are anticipated, further increasing financing costs for governments.

3.3. Effects on Debt

After the supply and demand shocks for each country were identified, the effects of these shocks on public debt were estimated by merging these series into an unbalanced panel with annual data from 1980 to 2022 from the IMF's World Economic Outlook, World Bank, and others.[7] To control for potential endogeneity issues, a dynamic panel regression is employed using the methodology proposed by Arellano and Bond (1991). The baseline specification is shown in Equation 3.

$$\Delta debt_{i,t} = \alpha_i + \gamma \Delta debt_{i,t-1} + \beta_1 supply_{i,t} + \beta_2 demand_{i,t} + \delta X_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

Where the relationship is captured between the change in debt-to-GDP ratio ($\Delta debt_{i,t}$), inflation supply shock ($supply_{i,t}$), inflation demand shock ($demand_{i,t}$), and a vector of control variables ($X_{i,t-1}$). The baseline set of controls includes the real exchange rate depreciation, real GDP growth rate, quality of the fiscal rule in place, and a governance indicator, among others.

To address potential endogeneity concerns, the Generalized Method of Moments (GMM) System estimator is employed to instrument $\Delta debt_{i,t-1}$, primary balance as a percent of GDP and stock-flow adjustment. The inclusion of the stock-flow adjustment is crucial, as highlighted by Moreno-Badia, Gamboa-Arbeláez, and Xiang (2022), particularly during fiscal crises in emerging markets and low-income developing economies. This adjustment can arise due to factors such as valuation effects resulting from depreciation on foreign currency–denominated debt or below-the-line operations, including government guarantees, state-owned enterprise bailouts, or transactions in financial assets. Controlling for the stock-flow adjustment allows for better analysis of potential increases in debt levels.

Our hypothesis is that the coefficient β_1 associated with the supply shock will have a positive sign, indicating that an inflationary supply shock leads to an increase

[7] See Table A2 in the Appendix for a definition of all the variables and sources used.

in the debt-to-GDP ratio. This aligns with the notion that higher financing costs for the government arise from sustained high inflation expectations. Conversely, we expect the coefficient β_2 accompanying the demand shock to have a negative sign, suggesting that a demand-driven increase in inflation is associated with a reduction in the debt-to-GDP ratio. This result may support the debt erosion hypothesis.

Section 4 presents our findings and discusses the mechanisms that potentially explain the overall relationship observed between debt and inflation. Specifically, the debt decomposition equation is employed to explore the various factors influencing debt accumulation. Doing so offers insights into the underlying drivers shaping the relationship between debt dynamics and inflation.

4. Results

This section presents the empirical results obtained from the analysis, building upon the methodology described in the previous section, which encompassed both the SVAR and the Arellano-Bond regression analyses. The chosen empirical strategy provided meaningful insights and allowed for conclusions to be drawn based on the outcomes of these analyses. The following subsections highlight the key findings, providing a comprehensive understanding of the relationship between the identified shocks and their impact on public debt.

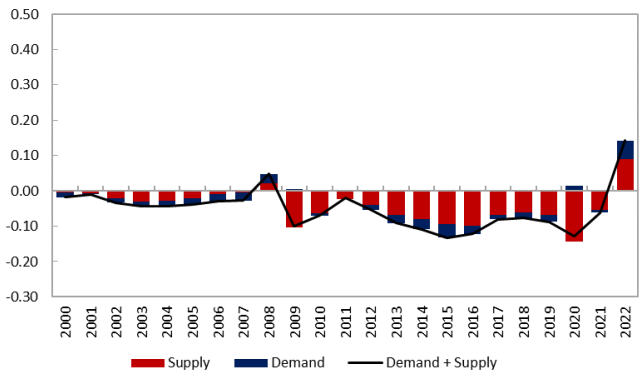
4.1. Supply and Demand Shocks

Figure 1 shows the annual contribution of demand and supply shocks to inflation for advanced economies, for emerging markets excluding LAC, and for LAC.[8] We can interpret these numbers as long run deviations from the mean of the inflation rate for the economies. Before 2020 countries were well below the mean of inflation rate, but the current situation has precipitated a change in the sign of the shocks indicating that the inflation rate (and the contribution of the shocks) is above average.

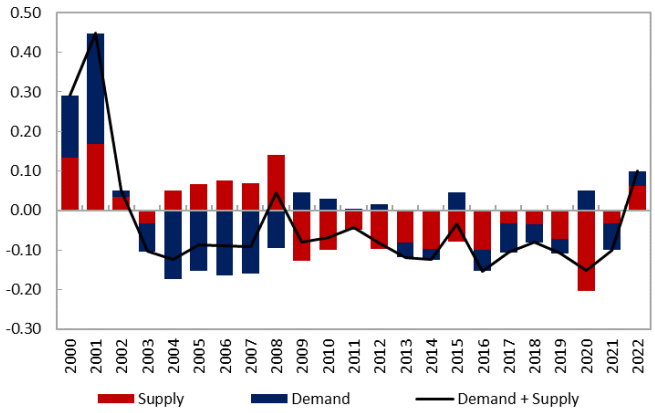
[8] The supply and demand shocks represent yearly changes.

Figure 1. Historical Decomposition of Inflation

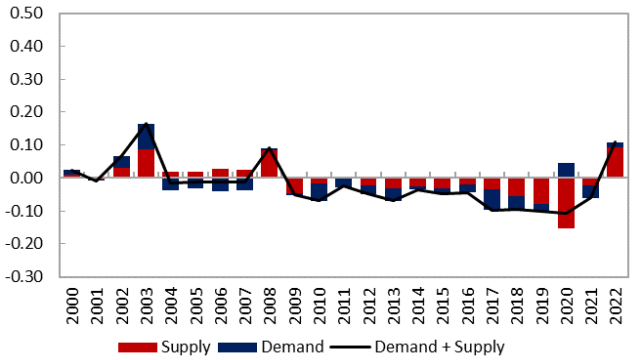
A. Advanced Economies



B. Emerging Markets (excl. LAC)



C. Latin America and the Caribbean



Note: The figures show the simple average of the demand and supply shocks across income groups.

For advanced economies, the inflation rates in the early part of the sample were below long run averages and the contribution of the identified shocks was not very large. In 2020 there is a clear effect of the supply shocks, and it is apparent that they were the main contributor to the low inflation rates that were in place that year. Nevertheless, the effect of supply and demand shocks contribute more to a higher inflation rate in both 2021 and 2022. In 2021 the supply chain bottlenecks are visible as well as the effect of demand pressures by the fiscal stimulus and the shift from services to goods. Note that for 2022 the increase in the contribution of the shocks is significant. The main contributor in this case is supply, which could be explained by recent disruptions in the energy market following the Russian invasion of Ukraine.

For emerging markets, the tendency is the same. For the early years, the sample inflation rates were lower than long run averages. The effect of the COVID-19 pandemic starting in 2020 follows the same logic as that of the advanced economies. Note that for LAC the contribution on the spike of inflation rates is bigger than the contribution identified for the rest of the emerging markets, and it is mostly driven by the supply shock.

LAC is treated as a different set of countries from emerging markets given that during the COVID-19 pandemic they experienced higher increases in debt levels, around 15 percent of GDP, compared to 10 percent of GDP for emerging market economies. Overall, for the time series data available, the mean inflation rates for LAC countries were lower than for the rest of the emerging market economies. Hence, the average supply and demand shocks are higher for emerging countries excluding LAC. Separating the countries into these two groups allows for better control for heterogeneity across the income group, given that grouping all emerging market economies together downplays the variability and levels of the supply and demand shocks within LAC countries.

4.2. Asymmetric Effect on Debt

Table A3 in the Appendix shows the results of a fixed effects panel regression between the change in debt-to-GDP ratios and inflation. As seen in column (1), the overall correlation between inflation and debt to GDP is negative and statistically significant. Even when the supply and demand shocks are included the results show that the relationship between them is negative and statistically significant as well. This negative relationship highlights the debt dilution channel, but as will become evident in the next regressions the relationship between debt and inflation needs careful examination as this negative sign is dependent on the source of the inflation surge as well as on a country's debt levels.

Table 2 shows the estimation results of equation (1). Our baseline specification is indicated in column (1). The baseline specification controls for the lag of real depreciation and lag of real GDP growth as well as interaction terms between

emerging markets (excluding LAC) and the supply and demand shocks; the same is presented for advanced economies. Our hypothesis is verified by these results. The coefficient that accompanies the demand shock is negative and significant at the 10 percent level, suggesting that higher inflation rates correlated with demand shocks tend to reduce the debt level. This result is consistent with the debt dilution hypothesis where inflation rates reduce debt levels. The coefficient from the supply shocks is positive and significant to the 1 percent level, suggesting that higher inflation rates associated with supply shocks tend to increase the level of debt in a country. The interaction terms indicate that the effect of supply and demand shocks is smaller for emerging markets other than those from Latin America. This may be the case because Latin America experienced high inflation rates in the 1980s and is more susceptible to having high inflation rates affect the level of debt.

Column (2) of Table 2 adds an institutional level control and finds that the results do not change. Column (3) shows that controlling for the presence of a fiscal rule reduces the effect of the inflationary demand and supply shocks on debt levels, but the same effect for demand and supply shocks as the baseline specification are present. In particular, the financial openness index and the rents from oil, mineral, and gas do not alter the conclusions drawn above (columns 4 and 5).

A dummy is included that captures if a country is in a fiscal crisis. Data is used from Medas et al. (2018), which indicates that a country is in a fiscal crisis if any of the following criteria is met:

- Credit events: A crisis is triggered when the debt service is not paid on the due date, or the creditor incurs any other type of losses including through debt restructuring.
- Exceptionally large official financing: Episodes where the country receives large financial support from the IMF or the European Union.
- Implicit domestic public debt default: Two criteria are considered: (1) periods of high inflation or (2) accumulation of domestic arrears.
- Loss of market confidence: Episodes associated with extreme market pressures as proxied by (1) loss of market access, capturing sovereign

defaults or bond issuance coming to a halt; or (2) very large borrowing costs or sovereign yield spikes.

Note that the fiscal crisis criteria categorizes when a country is going through a debt dilution phase (i.e., criteria number 3). The results in column (6) show that if a country is experiencing a fiscal crisis, debt levels tend to go up as the country is facing high fiscal distress. The results on the coefficients of supply and demand shocks remain the same.

Finally, we control for heterogeneous effects given debt levels. A dummy is included that indicates if the country has a high or low level of debt. A country is considered to have a high level of debt if its debt-to-GDP ratio is above the 75^{th} percentile of the sample and the dummy is interacted with both the supply and demand shocks. A country with a low level of debt is one with a debt-to-GDP ratio below the 25^{th} percentile of the sample. Columns (7) and (8) show that the effect of supply and demand shocks on the change of debt are significant for highly indebted countries. The negative effect is larger for countries that have low levels of debt in column (8). The results in column (7) highlight that for countries with high levels of debt the effect of both the supply and demand shock are larger. Even though demand shocks cause debt dilution, a country must be cautious when identifying if the inflation rates are originating from a supply or demand shock because in the medium term the outcome might not be favorable if the supply shock is more influential.

Table 2. Dynamic Panel Regression – Debt-to-GDP Ratio

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	-0.588**	-0.647**	-0.556***	-0.502**	-0.559*	-0.476*	-0.557***	-0.759***
	(0.229)	(0.280)	(0.192)	(0.238)	(0.294)	(0.243)	(0.200)	(0.273)
Supply Shock	0.514***	0.557***	0.429***	0.479**	0.490**	0.396**	0.378	0.444*
	(0.157)	(0.186)	(0.160)	(0.222)	(0.218)	(0.178)	(0.238)	(0.245)
Emerging Markets (No LAC) X Demand Shock	0.484*	0.546*	0.448**	0.408	0.477	0.385	0.410*	0.577*
	(0.256)	(0.310)	(0.207)	(0.285)	(0.307)	(0.275)	(0.224)	(0.295)
Advanced Economies X Demand Shock	-0.009	0.032	0.012	-0.084	-0.105	-0.195	0.008	-0.029
	(0.255)	(0.268)	(0.234)	(0.227)	(0.348)	(0.295)	(0.249)	(0.276)
Emerging Markets (No LAC) X Supply Shock	-0.607***	-0.648***	-0.527***	-0.564**	-0.561**	-0.480**	-0.516**	-0.550*
	(0.164)	(0.184)	(0.165)	(0.240)	(0.217)	(0.196)	(0.225)	(0.314)
Advanced Economies X Supply Shock	0.430	0.412	0.386	0.566*	0.497	0.875**	0.460*	0.475
	(0.294)	(0.273)	(0.233)	(0.338)	(0.303)	(0.361)	(0.263)	(0.304)
High Debt x Demand Shock							-0.522**	
							(0.202)	
High Debt x Supply Shock							0.398*	
							(0.204)	
Low Debt x Demand Shock								0.297*
								(0.167)
Low Debt x Supply Shock								0.228
								(0.167)
Observations	1,173	1,173	1,173	1,112	1,173	1,091	1,173	1,173
Number of countries	50	50	50	50	50	50	50	50

Note : Six to seven lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
The reference group is LAC.

5. Mechanisms of Transmission

This section delves into the mechanisms that underlie the effects of supply and demand shocks on debt levels, following the debt decomposition equation below.

$$d_t - d_{t-1} = int_t - pb_t + \frac{\Delta F_t(1-\alpha_{t-1})}{(1-\gamma_t)} d_{t-1} - \frac{\pi_t}{(1+\gamma_t)} d_{t-1} - \frac{g_t}{(1+g_t)} d_{t-1} + sfa_t \quad (4)$$

Where $(1+\gamma_t) = (1+g_t)(1+\pi_t)$, d_t is the debt-to-GDP ratio, g_t represents the GDP growth rate, and π_t denotes the inflation rate. Additionally, pb_t represents the primary balance, int_t is the interest payments, ΔF_t denotes the annual variation of the exchange rate, α_{t-1} is the share of public debt in domestic currency, and sfa_t for the stock-flow adjustment. Understanding these mechanisms is of utmost importance for policymakers and researchers as it provides valuable insights into the drivers of changes in debt levels. Specifically, the focus is on three main channels: financing costs, budget changes, and exchange rate depreciation. The same panel regression described in equation (3) is conducted, changing the dependent variable for the 10-

year bond spread or credit rating to test the financing costs channel and primary balance–to-GDP ratio for budget changes.

5.1. Financing Costs

The evidence shown in Table 2 speaks to the possibility of having inflation rates caused by supply shocks that increase debt levels. According to the debt accumulation equation there are several mechanisms that would cause the debt level to increase. One of them is through the interest rate or cost of borrowing. To capture the cost of borrowing, the dataset on Covered Interest Rate Parity Deviations from Du, Im, and Schreger (2018) is used with their 10-year bond spreads as a proxy.

Table 3 shows the results of the regressions. The results suggest that inflation rates caused by supply shocks increase the 10-year bond spread while demand shocks seem to have no effect on 10-year bond spreads. There are no differences across income groups. The increase in the spread caused by the supply shock might be suggestive of higher expected borrowing costs for the fiscal authority. As monetary policy responds to the inflation shock to avoid a possible un-anchoring of inflation expectations, interest rates are rising, which leads to higher borrowing costs. Since the shocks seem to be more persistent when caused by supply disruptions, in the medium term governments will face higher borrowing costs, which immediately translates into a higher value of debt. Adding additional controls to the regression does not alter the results. Financial openness does not alter the results and is not significant at the 10 percent level.

Since information for the bond spreads is not available for all countries in the sample, as a robustness check additional regressions were conducted using countries' Fitch credit ratings. The interest rate that a country must pay is highly correlated with the credit rating of its bonds in the international markets. A numerical variable is used to indicate the quality of the bond. Table 4 shows the classification followed when assessing a country's rating. Information for this measure is available for all countries in the sample, in contrast with information for the bond spreads, which is only available for 26 countries in the sample.

Table 1. Dynamic Panel Regression – 10-Year Bond Spread

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	0.144	0.071	0.113	0.136	0.201	0.138	0.081	0.056
	(0.149)	(0.119)	(0.117)	(0.197)	(0.176)	(0.108)	(0.120)	(0.181)
Supply Shock	0.186	0.249**	0.213*	0.233*	0.279*	0.162	0.132	0.267
	(0.113)	(0.100)	(0.113)	(0.135)	(0.152)	(0.140)	(0.163)	(0.164)
Emerging Markets (No LAC) X Demand Shock	-0.119	0.023	-0.035	-0.067	-0.209	-0.138	0.089	0.075
	(0.166)	(0.163)	(0.138)	(0.312)	(0.179)	(0.159)	(0.223)	(0.266)
Advanced Economies X Demand Shock	-0.101	-0.030	-0.051	-0.094	-0.120	-0.096	0.006	-0.046
	(0.198)	(0.159)	(0.205)	(0.207)	(0.207)	(0.129)	(0.197)	(0.220)
Emerging Markets (No LAC) X Supply Shock	-0.084	-0.173	-0.126	-0.161	-0.142	-0.035	-0.137	-0.185
	(0.146)	(0.133)	(0.146)	(0.208)	(0.171)	(0.184)	(0.144)	(0.204)
Advanced Economies X Supply Shock	-0.068	-0.156	-0.135	-0.136	-0.208	-0.118	-0.107	-0.199
	(0.144)	(0.167)	(0.141)	(0.164)	(0.203)	(0.189)	(0.157)	(0.231)
High Debt x Demand Shock							-0.083	
							(0.074)	
High Debt x Supply Shock							0.198	
							(0.211)	
Low Debt x Demand Shock								0.099
								(0.313)
Low Debt x Supply Shock								-0.041
								(0.069)
Observations	441	441	441	416	441	417	441	441
Number of countries	24	24	24	24	24	24	24	24

Note: Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The reference group is LAC.

Table 4. Fitch Ratings

Rating	Numerical value	Rating	Numerical value
AAA	20	BB+	10
AA+	19	BB	9
AA	18	BB-	8
AA-	17	B+	7
A+	16	B	6
A	15	B-	5
A-	14	CCC+	4
BBB+	13	CCC	3
BBB	12	CCC-	2
BBB-	11	D	1

Source: Authors' calculations with information from Fitch Rating.

Table 5 shows the results of using the rating of the bonds as the dependent variable instead of the 10-year bond spreads. The overall results do not change. A supply shock decreases the credit ratings, which translates to a higher interest rate, while the demand shock seems to have some effect on the credit ratings. The last four columns show a positive coefficient, which might indicate the debt dilution hypothesis. Note that there are significant differences by income groups. The results suggest that the effects are larger for LAC countries than for other emerging market and advanced economies. This could again be influenced by the sovereign debt crisis that the region experienced in the 1980s and early 1990s.

Table 5. Dynamic Panel Regression – Credit Ratings

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	14.110	11.902*	12.229	14.155	14.630**	14.122**	14.727*	12.068***
	(8.627)	(6.003)	(8.912)	(12.081)	(7.010)	(6.855)	(8.302)	(4.233)
Supply Shock	-9.440***	-8.217***	-8.538***	-8.257**	-9.467***	-7.900***	-9.240***	-6.925**
	(2.129)	(2.805)	(2.317)	(3.245)	(2.122)	(2.881)	(2.757)	(2.965)
Emerging Markets (No LAC) X Demand Shock	-14.975*	-13.994**	-12.861	-14.455	-15.836**	-13.904**	-15.375*	-13.097***
	(8.646)	(5.771)	(8.811)	(12.090)	(7.237)	(6.816)	(8.465)	(4.027)
Advanced Economies X Demand Shock	-13.048	-10.363	-10.844	-12.820	-13.173*	-11.825	-14.111	-10.131**
	(9.023)	(6.462)	(9.683)	(13.245)	(7.539)	(7.178)	(8.872)	(4.852)
Emerging Markets (No LAC) X Supply Shock	8.503***	6.010*	7.837***	7.878**	8.233***	8.020***	8.529***	5.753
	(2.227)	(3.195)	(2.483)	(3.564)	(2.163)	(2.999)	(2.854)	(3.461)
Advanced Economies X Supply Shock	5.982	5.221	3.865	4.742	5.511	0.812	5.055	3.661
	(3.885)	(4.315)	(4.760)	(5.469)	(4.492)	(5.421)	(5.288)	(5.984)
High Debt x Demand Shock							0.773	
							(1.085)	
High Debt x Supply Shock							0.884	
							(1.167)	
Low Debt x Demand Shock								-2.045
								(1.925)
Low Debt x Supply Shock								-1.823
								(1.970)
Observations	1,331	1,331	1,331	1,259	1,331	1,211	1,331	1,331
Number of countries	52	52	52	52	52	52	52	52

Note: Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The reference group is LAC.

5.2. Primary Balance

Another possible transmission mechanism for the increase in the level of debt is the primary balance. As before, the dynamic panel regression is estimated as in equation (3) where the dependent variable is the change in the primary balance (or primary deficit) to GDP ratio and the endogenous variable to be instrumented is the level of debt. Table 6 shows the results. The baseline specification shows that the demand

shock to inflation is associated with a decrease in the fiscal deficit. Since demand shocks are associated with higher GDP, this is consistent with a decrease in the deficit of the fiscal authority. Supply-side effects do not have a significant effect on the primary balance to GDP. Additional controls are added, and the results hold for all specifications. Higher quality of the fiscal rule leads to a decrease in the fiscal deficit and the effects are higher for countries that have higher levels of debt.

Table 6. Dynamic Panel Regression – Primary Balance to GDP

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	-0.393**	-0.375**	-0.481*	-0.429*	-0.423	-0.462**	-0.307*	-0.386**
	(0.165)	(0.181)	(0.264)	(0.214)	(0.261)	(0.200)	(0.180)	(0.174)
Supply Shock	0.215	0.211	0.254	0.244*	0.254	0.260	0.134	0.222*
	(0.133)	(0.137)	(0.182)	(0.128)	(0.206)	(0.168)	(0.134)	(0.118)
Emerging Markets (No LAC) X Demand Shock	0.394**	0.380*	0.496*	0.428*	0.435	0.467**	0.309	0.370**
	(0.173)	(0.192)	(0.278)	(0.222)	(0.269)	(0.208)	(0.204)	(0.175)
Advanced Economies X Demand Shock	-0.021	-0.050	0.093	0.067	0.018	0.024	0.062	-0.016
	(0.193)	(0.197)	(0.296)	(0.226)	(0.296)	(0.251)	(0.189)	(0.203)
Emerging Markets (No LAC) X Supply Shock	-0.211	-0.204	-0.238	-0.244*	-0.240	-0.255	-0.131	-0.214*
	(0.140)	(0.145)	(0.188)	(0.134)	(0.209)	(0.173)	(0.133)	(0.124)
Advanced Economies X Supply Shock	0.268	0.250	0.199	0.275*	0.213	0.364	0.220	0.239
	(0.184)	(0.163)	(0.228)	(0.158)	(0.241)	(0.242)	(0.163)	(0.181)
High Debt x Demand Shock							-0.376***	
							(0.110)	
High Debt x Supply Shock							0.159*	
							(0.091)	
Low Debt x Demand Shock								0.014
								(0.094)
Low Debt x Supply Shock								-0.008
								(0.059)
Observations	1,212	1,212	1,212	1,148	1,212	1,124	1,212	1,212
Number of countries	52	52	52	52	52	52	52	52

Note: Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The reference group is LAC.

Given that the primary balance is composed of revenues from the government as well as expenditure we delve into understanding where the effect of the increase in the primary balance is coming from. First, instead of having the primary balance as the dependent variable, the change in revenues to GDP is used. Table 7 shows the results. Demand shocks are positively and statistically significantly correlated with increase in revenues. This result is consistent because demand shocks tend to happen when GDP is growing, which leads to stronger demand, which translates into higher taxes or revenues for the government. Supply shocks do not seem be correlated with government revenues.

Table 8 shows the results of the regression when the dependent variable is government expenditure. The results are consistent with those found for the revenues channel. A stronger demand (or higher GDP), which is consistent with the demand shock, should lower government expenditures as fiscal policy is countercyclical. Nonetheless, the results are not statistically significant for all specifications. The results suggest that inflation that is caused by demand shocks tends to be correlated with lower government expenditures. Inflation supply shocks do not have a significant relationship with government expenditures.

Table 7. Dynamic Panel Regression – Revenues to GDP

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	0.252**	0.230*	0.239*	0.227***	0.260**	0.214*	0.216*	0.237*
	(0.119)	(0.126)	(0.137)	(0.085)	(0.120)	(0.113)	(0.115)	(0.125)
Supply Shock	0.012	0.001	-0.001	0.052	0.018	0.063	-0.049	0.015
	(0.104)	(0.104)	(0.109)	(0.092)	(0.106)	(0.087)	(0.089)	(0.104)
Emerging Markets (No LAC) X Demand Shock	-0.281**	-0.257*	-0.266*	-0.258**	-0.289**	-0.250*	-0.262**	-0.262*
	(0.130)	(0.137)	(0.149)	(0.098)	(0.129)	(0.126)	(0.127)	(0.134)
Advanced Economies X Demand Shock	-0.200	-0.181	-0.190	-0.173*	-0.212*	-0.151	-0.181	-0.181
	(0.131)	(0.135)	(0.146)	(0.094)	(0.126)	(0.131)	(0.121)	(0.133)
Emerging Markets (No LAC) X Supply Shock	-0.042	-0.029	-0.027	-0.084	-0.048	-0.101	0.002	-0.041
	(0.103)	(0.104)	(0.110)	(0.087)	(0.107)	(0.089)	(0.094)	(0.107)
Advanced Economies X Supply Shock	0.048	0.060	0.054	0.024	0.039	0.024	0.098	0.057
	(0.125)	(0.129)	(0.134)	(0.119)	(0.126)	(0.110)	(0.113)	(0.125)
High Debt x Demand Shock							0.022	
							(0.067)	
High Debt x Supply Shock							0.064	
							(0.055)	
Low Debt x Demand Shock								-0.003
								(0.023)
Low Debt x Supply Shock								-0.004
								(0.016)
Observations	1,243	1,243	1,243	1,179	1,243	1,151	1,243	1,243
Number of countries	52	52	52	52	52	52	52	52

Note: Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The reference group is LAC.

Table 8. Dynamic Panel Regression – Expenditures to GDP

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	-0.363	-0.476*	-0.329	-0.219	-0.385*	-0.455	-0.323	-0.366*
	(0.230)	(0.248)	(0.218)	(0.204)	(0.203)	(0.279)	(0.199)	(0.212)
Supply Shock	0.196	0.188	0.174	0.143	0.215	0.165	0.142	0.163
	(0.177)	(0.210)	(0.148)	(0.157)	(0.192)	(0.230)	(0.156)	(0.172)
Emerging Markets (No LAC) X Demand Shock	0.358	0.480*	0.325	0.207	0.380*	0.459	0.330	0.341
	(0.232)	(0.248)	(0.218)	(0.211)	(0.203)	(0.283)	(0.203)	(0.216)
Advanced Economies X Demand Shock	0.039	0.143	0.008	-0.119	0.053	0.048	0.175	0.054
	(0.245)	(0.275)	(0.249)	(0.221)	(0.221)	(0.313)	(0.221)	(0.230)
Emerging Markets (No LAC) X Supply Shock	-0.200	-0.184	-0.178	-0.154	-0.219	-0.163	-0.135	-0.162
	(0.182)	(0.220)	(0.157)	(0.160)	(0.198)	(0.237)	(0.167)	(0.180)
Advanced Economies X Supply Shock	0.459**	0.454*	0.451**	0.508**	0.442*	0.547**	0.352*	0.494**
	(0.216)	(0.257)	(0.185)	(0.192)	(0.227)	(0.266)	(0.195)	(0.218)
High Debt x Demand Shock							-0.356***	
							(0.129)	
High Debt x Supply Shock							0.101	
							(0.071)	
Low Debt x Demand Shock								0.025
								(0.062)
Low Debt x Supply Shock								-0.000
								(0.048)
Observations	1,243	1,243	1,243	1,179	1,243	1,151	1,243	1,243
Number of countries	52	52	52	52	52	52	52	52

Note: Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The reference group is LAC.

5.3 Exchange Rate

Finally, given that the sample used includes emerging market economies, exchange rate movements hold great importance for understanding debt dynamics. Most of the countries analyzed have a significant share of their debt denominated in a currency other than their own. Even though it is evident that inflation rates are heavily affected by exchange rate movements (i.e., passthrough), our direct approximations do not show a significant effect of supply and demand shocks on changes in the exchange rate (refer to Table A4 in the Appendix). Hence, the effect is estimated of inflation demand and supply shocks on unanticipated movements in the exchange rate.

To capture unanticipated movements in the exchange rate, the exchange rate forecast from the World Economic Outlook (WEO) is used alongside the observed end-of-period exchange rate similar to Panizza (2020).[9] By calculating the percentage

[9] One-year forecast from WEO 1990 to 2022.

deviation of the forecasted exchange rate from the observed data point, we argue that this could be interpreted as unanticipated movements in the exchange.

Table 9 shows the results of the dynamic panel regressions with the unanticipated exchange rate fluctuations as the dependent variable. The findings reveal that both supply and demand shocks are positively and statistically significantly correlated with unanticipated currency depreciations. Higher inflation rates indicate that the local currency is worth less; hence, there is an increase in the depreciation rate. These results suggest that those supply and demand shocks have an incidence on unanticipated exchange rate fluctuations, which lead to higher levels of debt.

Table 9. Dynamic Panel Regression – Unanticipated Exchange Rate Movements

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	0.040***	0.040***	0.041***	0.036***	0.040***	0.036***	0.129*	-0.004
	(0.013)	(0.013)	(0.014)	(0.011)	(0.013)	(0.011)	(0.071)	(0.015)
Supply Shock	0.012*	0.013**	0.013**	0.011**	0.012**	0.012**	-0.001	0.022***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)	(0.014)	(0.004)
High Debt x Demand Shock							0.184	
							(0.184)	
High Debt x Supply Shock							0.434**	
							(0.210)	
Low Debt x Demand Shock								0.033
								(0.127)
Low Debt x Supply Shock								-0.076
								(0.132)
Observations	1,390	1,390	1,390	1,225	1,390	1,236	1,390	1,390
Number of countries	55	55	55	52	55	52	55	55

Note: Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Summarizing the results found so far, demand and supply shocks on inflation have differentiated effects on debt levels. Demand shocks that increase inflation are correlated with lower levels of debt and directly highlight the debt dilution channel. Moreover, they are also correlated with lower fiscal deficits, which also have a negative effect on debt levels. In contrast, supply shocks are associated with higher levels of debt ratios. The empirical evidence suggests that these supply shocks are correlated with higher financing costs that can lead to higher debt levels. Finally, the results indicate that these supply shocks are associated with decreases in credit ratings, which are directly proportional to higher interest rates faced by the government. Hence, the fiscal authority should be careful when assessing the impact of higher inflation on

debt-to-GDP ratios given the underlying nature of the inflation rise because it might have positive effects on debt levels.

6. Persistence of Demand and Supply Shocks Effects

A local projection estimation was conducted to gain insights into the persistence and cumulative effects of supply and demand shocks on debt levels. This approach, proposed by Jordà (2005), offers flexibility in handling panel data and avoids constraining the shape of the impulse response, making it less sensitive to misspecification. Several studies, such as Ramey and Zubairy (2018), Born, Müller, and Pfeifer (2020), and David, Guajardo, and Yepez (2019), have relied on this methodology to analyze fiscal policy. Following Jordà (2005), we estimated the impulse response functions to examine the cumulative impact of supply and demand shocks on public debt. Specifically, debt-to-GDP ratio for country i at time t is denoted as $debt_{i,t}$, and h represents the time horizon at the $shock_{i,t}$ and after. Therefore, the outcome variable $debt_{i,t+h} - debt_{i,t}$ approximates the cumulative change in percentage points of GDP. The regression model employed is expressed by the following equation:

$$debt_{i,t+h} - debt_{i,t} = \alpha_i^h + \beta_h shock_{i,t} + \gamma_h(L)x_{i,t-1} + \varepsilon_{i,t+h}^h \qquad \forall h = 1,2,3,4,5 \qquad (4)$$

Where $\gamma_h(L)$ is the lag operator and x is a vector with the same control variables included in the dynamic panel presented in Section 3.3.[10] The variable shock is the identified inflationary shock (either supply or demand) from the SVAR estimation. The model includes country fixed effects (α_i^h). The coefficient β_h measures the response of changes in debt at time $(t+h)$ to the shock at period (t). Therefore, the impulse

[10] The inclusion of control of corruption, fiscal rule quality, and financial openness is crucial for accounting for institutional factors within a country and capturing any changes that may have occurred in the institutional framework during the period of the local projections. Additionally, the incorporation of oil, mineral, and gas rents aims to control for potential asymmetries among countries with high levels of these rents, as well as their potential correlation with government debt increases or decreases.

response function is constructed as a sequence of the estimated β_h coefficients at each horizon. The estimation horizon is set to be five periods, and all control variables are lagged one year. Standard errors are calculated using Driscoll-Kray to control for heteroskedasticity, autocorrelation, and possible correlation between groups.

Table 10 presents the results of the estimation conducted to analyze the impact of an inflationary demand shock. The first row displays the coefficients associated with the baseline specification. In the baseline model, the same control variables as in the dynamic panel estimations are included: real exchange rate depreciation, primary balance, real GDP growth, and stock-flow adjustment. The results indicate that an inflationary demand shock has a substantial effect on reducing debt, which is consistent with previous estimations. Also, this impact is observed to persist over the medium term. Moreover, when considering additional variables, the results remain consistent, and the coefficients remain statistically significant.

Table 10. Inflation Demand Shock Impact on Debt Growth

Model	h = 1	h = 2	h = 3	h = 4	h = 5
Baseline	-0.010**	-0.020*	-0.029*	-0.035*	-0.036
Baseline + Control of corruption	-0.010**	-0.020*	-0.030*	-0.036*	-0.038
Baseline + Fiscal rule, 5-year lag	-0.008*	-0.014	-0.02	-0.023	-0.021
Baseline + Fiscal rule quality, 5-year lag	-0.009**	-0.015	-0.02	-0.02	-0.019
Baseline + Financial openness, 1-year lag	-0.008**	-0.015*	-0.021	-0.023	-0.021
Baseline + Commodity rents, 1-year lag	-0.010**	-0.019*	-0.027*	-0.033*	-0.035
Baseline + Fiscal crisis, 1-year lag	-0.010**	-0.019*	-0.028*	-0.034*	-0.037
Baseline + Debt % GDP	-0.032	-0.069*	-0.120**	-0.157**	-0.175*
Shock*Debt % GDP	-0.023	-0.053	-0.100*	-0.136*	-0.152*
Observations	1037	986	935	884	833

Note: Standard errors are calculated using Driscoll-Kray. *** p<0.01, ** p<0.05, * p<0.1.

Table 11 displays the results regarding the persistence of inflation supply shocks on the debt level. Consistent with the findings from the GMM System regressions, a supply shock leads to an increase in the level of debt. The baseline specification reveals that even after four years, this effect remains statistically significant. Furthermore, in the medium term, the debt level continues to rise following the occurrence of the supply shock. Across various specifications, the results consistently support the initial findings.

Table 11. Inflation Supply Shock Impact on Debt Growth

Model	h = 1	h = 2	h = 3	h = 4	h = 5
Baseline	0.012**	0.022***	0.028**	0.033*	0.033*
Baseline + Control of corruption	0.012***	0.023***	0.029**	0.035**	0.036*
Baseline + Fiscal rule, 5-year lag	0.010*	0.018**	0.021*	0.023	0.021
Baseline + Fiscal rule quality, 5-year lag	0.010**	0.018**	0.020*	0.02	0.018
Baseline + Financial openness, 1-year lag	0.009**	0.018**	0.020*	0.021*	0.018
Baseline + Commodity rents, 1-year lag	0.011***	0.022***	0.027**	0.032**	0.032*
Baseline + Fiscal crisis, 1-year lag	0.010**	0.021***	0.026**	0.032*	0.033*
Baseline + Debt % GDP	0.026***	0.046***	0.049***	0.064***	0.066***
Shock*Debt % GDP	0.017***	0.030***	0.030***	0.045***	0.046***
Observations	1037	986	935	884	833

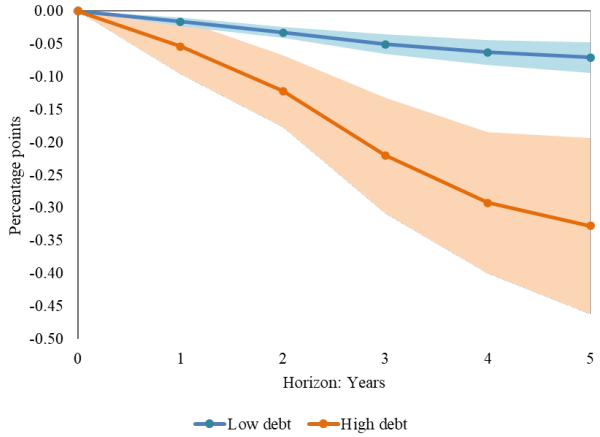
Note : Standard errors are calculated using Driscoll-Kray. *** p<0.01, ** p<0.05, * p<0.1.

In the last two rows of Tables 10 and 11, an interaction term between the shock and the debt-to-GDP ratio is introduced to examine if there is a heterogeneous response to shocks based on varying debt levels. To visualize this relationship, Figure 2 illustrates the response of both countries with low levels of debt and countries with high debt levels.

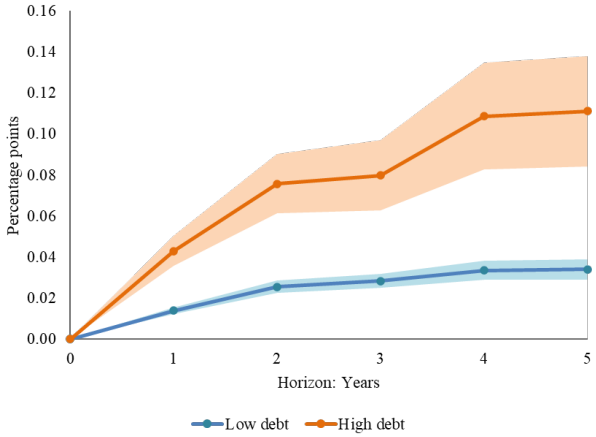
The findings reveal that for both types of shocks, countries with higher levels of debt are more vulnerable and experience a stronger impact. Specifically, when an inflationary supply shock occurs in the presence of high debt, the increase in indebtedness tends to be more than three times higher compared to countries with low debt levels. Similarly, in the case of a demand shock with high debt, the impact is more than four times higher. This analysis highlights the importance of prudent debt levels in shaping the response to shocks, emphasizing the greater vulnerability and amplified consequences faced by countries with higher levels of indebtedness.

Figure 2. Shock Impact with High Debt Levels

Panel A. Demand Shock



Panel B. Supply Shock



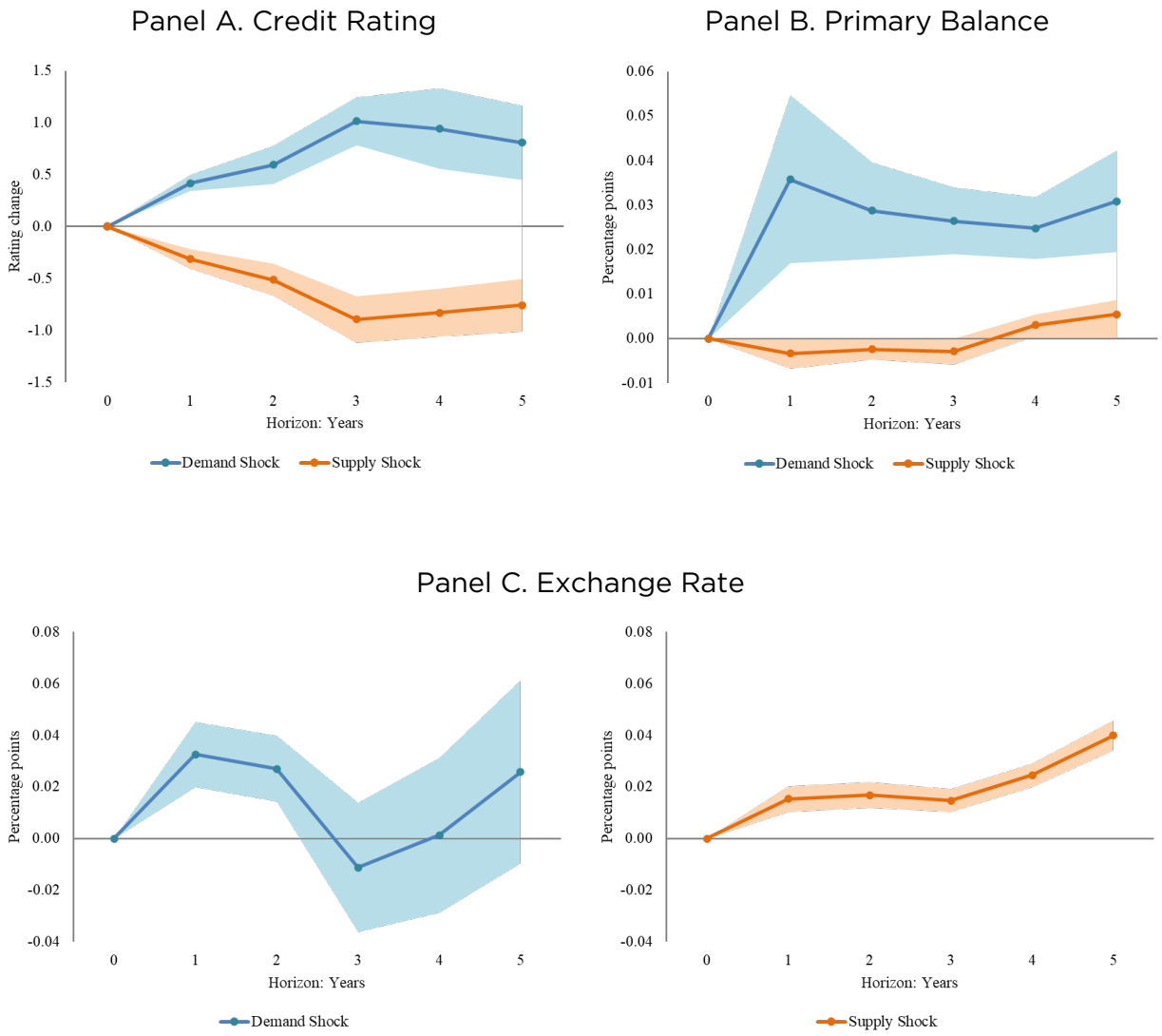
Note: High debt corresponds to debt above 75th percentile of the sample (70 percent of GDP). Low debt corresponds to debt below 25th percentile of the sample (30 percent of GDP). Shaded areas indicate 90 percent confidence intervals.

The persistence of transmission mechanisms plays a crucial role in understanding the long-term effects of shocks. The analysis, finds that the impact on financing costs exhibits a high level of persistence, lasting for at least five periods (see Figure 3, Panel A). Interestingly, the opposite effects for demand and supply shocks are observed. Demand shocks lead to an increase in credit ratings, indicating improved financing conditions, while supply shocks result in a decrease in credit ratings, indicating tightened financing conditions. These findings corroborate the results obtained in the previous exercise. Additionally, the impact on the primary balance is only significant in the case of demand shocks (see Figure 3, Panel B). This suggests that demand shocks have a substantial influence on the government's ability to generate a surplus or reduce deficits in its budgetary position. Moreover, the improvement in the primary balance following a demand shock tends to be long-lasting, persisting for at least five years.

Finally, the results illustrated in Figure 3, Panel C suggest that both demand and supply shocks impact significantly and positively the exchange rate, reinforcing previous results. However, it is noteworthy that the influence of demand shocks on the exchange rate tends to diminish within a two-year time frame. In contrast, supply

shocks exhibit a more enduring effect on the exchange rate, persisting for a minimum of five years. Given the prolonged impact of supply shocks on the exchange rate, they can impose a more significant increase in the debt burden compared to demand shocks.

Figure 3. Mechanisms of Transmission



Note: Shaded areas indicate 90 percent confidence intervals.

7. Additional Robustness Checks

So far, the regressions conducted include variables in terms of GDP. Because we want to estimate the effect of the supply and demand shocks on the levels of debt, several exercises were conducted to verify that the results hold when controlling for possible effects of the GDP. Equation 3 is estimated by changing the dependent variable for (i) the change in general government debt in local currency, (ii) general government debt in period t to GDP in period t-1, and (iii) controlling for the log-level of debt in period t-1 to control for possible debt overhang effects.

The results hold when these additional exercises were conducted.[11] Supply shocks remain statistically significant and are associated with an increase in the level of debt while the demand shocks lose significance when analyzing only the effect on the change in debt levels. The results hold when the dependent variable is changed to be the general government debt in period t to GDP in period t-1, which captures the increase in the debt level abstracting from possible effects of GDP growth. The supply shock increases the ratio while the demand shocks decrease it. For highly indebted countries the effect of demand shocks is no longer significant as with the baseline specification. Finally, including the lag of GDP to control for possible debt overhang effects instead of controlling for GDP growth yields the same results as in the baseline specification. Hence, we conclude that the results are robust to different specifications as well as different measures of increase in debt levels.

8. Conclusions

This paper provides valuable insights into the relationship between inflation supply and demand shocks and government debt. The analysis, employing a sign-restricted SVAR and dynamic panel regressions, reveals significant findings with important policy implications. First, supply shocks, characterized by a positive correlation with inflation and a negative correlation with GDP growth, are associated with increases in government debt. This finding suggests that policymakers and fiscal authorities should

[11] Results are available upon request to the authors.

exercise caution and adopt prudent fiscal measures in response to supply shocks. In particular, they should be mindful of the potential long-lasting effects of supply shocks on inflation, which can lead to higher borrowing costs and ultimately increase the level of debt. Implementing measures such as expenditure controls, revenue enhancements, and structural reforms can help mitigate the adverse impact of supply shocks on government debt.

Additionally, the analysis shows that demand shocks, characterized by positive relationships with both inflation and GDP growth, are associated with decreases in government debt. Policymakers can potentially leverage these demand shocks to manage debt levels effectively. When demand-driven inflationary pressures arise alongside positive GDP growth, fiscal authorities could consider implementing debt management strategies that take advantage of favorable conditions. This could involve proactive debt reduction measures, such as increasing debt servicing payments or directing surplus revenues toward debt repayment, to capitalize on the dilution of the real value of debt caused by demand shocks.

Given that the supply and demand shocks have opposing effects on debt, policymakers should also note that these effects are more persistent and damaging for countries with high levels of debt. The analysis suggests that even five years after the initial increase of inflation the effects on the debt-to-GDP ratios are positive and significant. Fiscal authorities should be careful of high levels of debt given that these countries are more exposed to such shocks.

Considering the observed linkages between supply shocks, inflation, and borrowing costs, the findings emphasize the importance of coordination between monetary and fiscal authorities. Close collaboration and communication between these entities can enhance the effectiveness of policy responses to supply shocks. By aligning monetary policy actions with fiscal measures, authorities can mitigate the negative consequences of supply shocks on debt dynamics. Coordination may involve adjusting interest rates, implementing fiscal rules, or adopting joint fiscal-monetary strategies that consider the implications of supply shocks on borrowing costs and debt sustainability.

The results suggest that the response to inflation should differ depending on the underlying shock. If inflation is primarily driven by supply shocks, policymakers

need to be cautious about assuming a debt dilution dynamic, as the effects of supply shocks on debt are found to be more persistent. In contrast, demand shocks may offer an opportunity for debt reduction through the dilution of debt's real value. Policymakers should take this differentiation into account when formulating inflation targeting policies and debt management strategies.

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Appendix

Table A1. Country List

Advanced Economies		Emerging Market Economies	
• Australia • Austria • Belgium • Canada • Cyprus • Czech Republic • Denmark • Estonia • Finland • France • Germany • Greece • Hong Kong SAR • Ireland • Israel • Japan • Korea	• Latvia • Lithuania • Luxembourg • Malta • The Netherlands • New Zealand • Norway • Portugal • Slovak Republic • Slovenia • Spain • Sweden • Switzerland • United Kingdom • United States	• Brazil • Bulgaria • Chile • Colombia • Costa Rica • Croatia • Ecuador • El Salvador • Hungary • India • Jordan • Mexico • Paraguay • Philippines • Poland • Romania • Russia	• Serbia • South Africa • Thailand • Turkey • Ukraine • Uruguay

Table A2. Data Sources and Definitions

Variable	Source – Notes
SVAR Estimation	
Inflation rate	IMF (2006) – Percent change of consumer price index
GDP growth	IMF (2006) – Log change of GDP, real, seasonally adjusted
Dynamic Panel Estimation	
Change in debt	IMF (2023b) – Difference of ratio of general government gross debt to GDP
Real depreciation	IMF (2023b) – $\frac{1+Nominal\ depreciation}{1+inflation\ rate}$
Real GDP growth	IMF (2023b) – Percent change of GDP, constant prices

Primary balance	IMF (2023b) – General government primary net lending/borrowing
Stock-flow adjustment	IMF (2023b) – Change in gross debt explained by stock-flow adjustment as described by the debt dynamic equation
Control of corruption	Kaufmann and Kraay (2022) – Control of corruption estimate
Quality of fiscal rule	Andrian et al. (2022) – Average of quality indicator of (i) expenditure rule, (ii) budget balance rule, and (iii) debt rule based on IMF fiscal rules dataset
Financial openness	Chinn and Ito (2006) – Index measuring a country's degree of capital account openness
Rents	IMF (2023b) – Oil, mineral, and gas rents (% of GDP)
Fiscal crisis	Medas et al. (2018) – Dummy indicating if a country is in a fiscal crisis
10-year bond spread	Du, Im, and Schreger (2018) – Change in the 10-year covered interest rate parity (CIP) between government bond yields in the United States and other countries
Interest expenditure to GDP	World Bank (2023) – Interest payments include interest payments on government debt—including long-term bonds, long-term loans, and other debt instruments—to domestic and foreign residents

Table A3. Fixed Effects Panel Regressions. Dependent Variable: Debt to GDP

VARIABLES	(1)	(2)
Demand Shock		-0.241***
		(0.065)
Supply Shock		-0.127
		(0.098)
Inflation Rate	-0.645***	
	(0.237)	
Constant	0.031***	-0.000
	(0.009)	(0.003)
Observations	1,293	1,321
R-squared	0.174	0.184
Number of countries	50	51

Note : Four to five lags were used as instruments. Robust standard errors in pa

Table A4. Dynamic Panel Regressions. Dependent Variable: Exchange Rate Fluctuations

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demand Shock	-0.118	-0.098	-0.097	-0.052	-0.125	0.169	0.086	-0.074
	(0.625)	(0.648)	(0.620)	(0.682)	(0.639)	(0.705)	(0.619)	(0.684)
Supply Shock	0.090	0.143	0.046	0.105	0.019	-0.216	0.192	-0.009
	(0.407)	(0.318)	(0.406)	(0.484)	(0.444)	(0.434)	(0.439)	(0.510)
Emerging Markets (No LAC) X Demand Shock	0.534	0.525	0.502	0.521	0.545	0.307	0.337	0.435
	(0.699)	(0.730)	(0.693)	(0.724)	(0.688)	(0.780)	(0.694)	(0.753)
Advanced Economies X Demand Shock	0.110	0.093	0.119	-0.214	0.129	-0.394	-0.026	0.010
	(0.600)	(0.614)	(0.607)	(0.719)	(0.662)	(0.733)	(0.623)	(0.690)
Emerging Markets (No LAC) X Supply Shock	0.334	0.294	0.369	0.372	0.408	0.699	0.225	0.389
	(0.438)	(0.357)	(0.436)	(0.567)	(0.519)	(0.455)	(0.475)	(0.521)
Advanced Economies X Supply Shock	-0.936	-0.976*	-0.868	-1.049	-0.800	-0.897	-0.909	-0.815
	(0.648)	(0.577)	(0.579)	(0.681)	(0.646)	(0.746)	(0.651)	(0.715)
High Debt x Demand Shock							-0.157	
							(0.183)	
High Debt x Supply Shock							-0.149	
							(0.187)	
Low Debt x Demand Shock								0.189
								(0.283)
Low Debt x Supply Shock								0.160
								(0.260)
Observations	1,263	1,263	1,263	1,196	1,263	1,171	1,263	1,263
Number of countries	52	52	52	52	52	52	52	52

Note : Four to five lags were used as instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1