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Identifying external debt shocks in low- and middle-income countries [☆]

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ABSTRACT

Using a unique loan-level dataset from the World Bank's Debtor Reporting System, we construct new measures of external debt shocks for 120 low- and middle-income countries during the 1975–2018 period. We identify the shock in two steps by first calculating the difference between actual and predicted net disbursement on external debt obligation for each loan and then taking aggregation at the country-year level. During expansionary times, external debt shocks lead to persistent decreases in the external debt to GDP ratio, possibly due to the availability of other sources of financing. During recessionary episodes, however, we see heavy reliance on external debt financing for most of developing countries. This reliance is more substantial for countries with higher levels of external debt stock, raising serious concerns for debt distress in these countries and in their road to building resilience.

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1. Introduction

The Great Recession and ongoing increasing levels of indebtedness among low- and middle-income (LMY) countries have raised serious concerns about domestic and external debt sustainability in those countries. Despite these concerns, determining whether sovereign and external debt is sustainable in nature is always a difficult task when simultaneously assessing long-term solvency and short-term liquidity against the specific circumstances of individual countries. To properly capture the emergence of debt difficulties, and identify the factors contributing to such difficulties, we propose new measures of external debt shocks in line with the Debt Sustainability Analysis (DSA) methodology.¹ Our measure determines risk signals of external debt based on large financing deviations in net disbursements at the country-year level. This is important when

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¹ The IMF's DSA framework conducts domestic and external debt sustainability analyses, through assessing the countries' capacity to finance their policy objectives and service the ensuing debt without unduly large adjustments (IMF & World Bank, 2017). According to this framework, a country's vulnerability to a payment crisis is assessed through the path of debt indicators, based on a set of macroeconomic projections that articulate the government economic policies.

assessing the fiscal stance of LMY economies and can serve as a measure of early warning for how responsive macroeconomic policies must be to sustain these debt levels.

The newly proposed measure of external debt shocks is constructed as the difference between changes in actual and predicted net disbursements on external debt obligations. This difference provides a clear identification of external debt signals experienced in an economy going through slumps and booms. Our new measure does not rely on any assumption on the sustainability of external debt or the view of the economy. Using [Jorda's \(2005\)](#) local projection method, we assess the impact of external debt shocks on key macroeconomic variables and identify the key factors that determine developing countries' probability of external debt distress.

We find that the effect that external debt shocks have on the debt to GDP ratio depends on the state of the business cycle. During expansionary times, external debt shocks do not lead to persistent increases in the external debt to GDP ratio, possibly due to the availability of other sources of financing. During recessionary periods, however, we see heavy reliance on external debt financing for most of developing countries, especially for those with high levels of external debt stock, raising serious concerns for debt distress in LMY economies and in their road to building resilience. For those LMY economies.

Our paper is closely related to the literature on the identification of external and fiscal shocks. Broadly speaking, the identification strategy can be classified into two groups: (i) use of indicators and (ii) the narrative approach. The use of indicators has been widely implemented by official government agencies as well as international organizations, e.g. the European Commission, IMF, OECD, and the World Bank.² [Blanchard et al. \(1991\)](#) propose informal indicators by using tax gaps based on a comparison of the current debt-to-GDP figures with the corresponding multi-period ahead forecasts; see also [Polito and Wickens \(2012\)](#), [Horne \(1991\)](#), [Leeper \(2010\)](#) and [Polito and Wickens \(2011\)](#) point out the limitations of these indicators in serving as external and fiscal shocks.³

In order to address these limitations, we construct the measure of external debt shock by recalculating one-year ahead predictions on net disbursements based on the information available in a given year. By doing so, information on any policy changes and the state of the economy available in real time is incorporated in the measure. While the calculations of the predicted net disbursement do not follow a specific model, they do adhere to the terms of the contractual agreements established when these obligations were signed between the creditor and debtor entities. Therefore, they follow the specific pattern and timeline of principal payments and gross disbursements, making our measure transparent, testable and reproducible by others. The new measure captures the unexpected nature of the external debt shock and serves as a signal for the need for policy intervention when a large, negative shock hits the economy.

Turning to the narrative approach to identifying shocks, [Born et al. \(2020\)](#) aptly point out that these measures of shocks tend to co-move with the sovereign default premia, making the narrative identification strategy ill-fitting when investigating the effect of fiscal policy on sovereign default premium.⁴ In a similar vein, the narrative approach is not appropriate in our context since it includes policy actions aimed at controlling external debt and current account deficits that are highly correlated with the external default premia. In contrast, our measure of external debt shock addresses these specific concerns, because by construction, the new measure incorporates the information available in real time about both expectations and actual values of disbursement. Furthermore, we remove the same-year disbursements on new loan commitments, since they might be correlated with the state of the economy.

Our paper also makes contact with another strand of the literature on the state-dependence of external shocks and fiscal policies. Recent contributions include [Auerbach and Gorodnichenko \(2017\)](#), [Ramey and Zubairy \(2018\)](#), [Born et al. \(2020\)](#) and [Zhang et al. \(2019\)](#).⁵ Compared to these studies, we find that external debt shocks have negative impact on the external debt to GDP ratio during expansionary episodes, but the impact turns out to be significantly positive during recessionary periods. We believe that these estimates from 120 developing countries are informative for modern policy debates regarding the state-dependence of fiscal shocks.

The paper proceeds as follows. [Section 2](#) lays out the theory behind our identification strategy. [Section 3](#) describes the World Bank's Debtor Reporting System dataset. [Section 4](#) provides details in constructing external debt shocks. [Section 5](#) discusses the econometric methodology in estimating the impact of the shocks. [Section 6](#) provides empirical results on how external debt shocks affect the external debt to GDP ratio, by considering the state of the business cycle and the level of external debt. [Section 7](#) concludes. [Appendix A](#) presents the derivations of the external debt dynamics, [Appendix B](#) discusses an alternative measure of external debt shock and [Appendix C](#) provides an illustration of the measure of debt shock in Haiti and Mexico.

² The IMF and World Bank Debt Sustainability Analysis template examines the projections of debt-service ratios over forty years, while also noticing that the error of projections increases substantially with the length of the forecast horizon. The [European Commission \(2006\)](#) uses two indicators to assess the medium and long-term scope and scale of the sustainability challenge.

³ [Horne \(1991\)](#) notes that baseline projections assume no policy change and fail to incorporate agents' expectations on possible policy switches as the accumulated debt stock grows. According to [Leeper \(2010\)](#), these indicators are not transparent, testable or reproducible by others. [Polito and Wickens \(2011\)](#) argue that these indicators are likely to provide an inaccurate assessment of the fiscal stance since government expenditure projections are assumed independent from government revenue and private sector behavior.

⁴ [Bordo et al. \(2001\)](#) define financial crises as episodes of market volatility marked by significant problems of illiquidity and insolvency among market participants. [Reinhart and Rogoff \(2014\)](#) offer a "panoramic" analysis of the history of financial crises, including international debt and banking crises, inflation, currency crashes and debasements. [Schularick and Taylor \(2012\)](#) expand on these two studies for the event analysis of banking crises. In line with [Ramey \(2011\)](#) and [Romer and Romer \(2010\)](#), [Devries et al. \(2011\)](#) identify fiscal consolidation actions by examining contemporaneous policy documents.

⁵ There is a parallel literature on the state-dependence of monetary policy; see [Aastveit et al. \(2017\)](#), [Furceri et al. \(2018\)](#), and the references therein.

2. External debt dynamics

External debt dynamics in this study follow the World Bank and IMF DSA framework, which consists of two complementary components on the analysis of the sustainability of total public debt and external debt. The analysis of external-debt sustainability focuses on the country's flows with the rest of the world and is based on the residency concept. By contrast, fiscal sustainability analysis in the DSA framework centers on liabilities of the public sector to residents as well as nonresidents of the economy.

Consequently, the evolution of external debt (D_{t+1}) is represented by:

$$D_{t+1} = (1 + r_f)DF_t + (1 + r_d)(1 + \varepsilon)DD_t - TB_{t+1} \quad (1)$$

where TB_{t+1} is the non-interest current account balance, and ε represents the change in exchange rate defined in terms of U.S. dollars per local currency. Eq. (1) states that external debt is composed of external debt denominated in both foreign currency (DF) and domestic currency (DD)⁶. A change in the current account balance can increase the need for external financing and affect the external debt sustainability of a country. Instead of looking at each of these channels separately, we estimate the effect of external debt shocks on the stock of external debt at time t , as well as on its future values. This will allow us to estimate the effect directly and analyze how external policy responds to external shocks in LMY countries, while still controlling for the effect of the components in the external debt equation.

The accurate identification of external debt distress episodes is of high importance. The challenges are to recognize the distress signals and identify the conditions under which a country is experiencing external debt difficulties in a timely manner. According to the current DSA methodology for low-income countries, the emergence of debt difficulties can be captured at the time the cumulative IMF disbursements exceed 50 percent of members quota (IMF & World Bank, 2017). While this identification strategy is important in recognizing debt distress episodes, distress signals could be missed or called late when using this approach. In the latest recommendations made for the DSA model by the IMF and the World Bank, improvements have been proposed and are in the process of being implemented to include large upfront financing disbursements. These disbursements occur in situations where countries are facing large financing needs but without alternate financing sources.

In line with this theory, we propose an enhanced identification strategy constructed as the difference between actual and predicted net disbursements. Net disbursements represent the difference between gross disbursement and gross principal payment figures as defined in the World Bank's Debtor Reporting System methodology (World Bank, 2010). Based on the original terms of each individual external debt instrument, loan or bond, we construct a predicted schedule of gross principal payments to be paid at one-year ahead. Furthermore, we incorporate the loan-level disbursement profiles, constructed according to the specifications detailed in Section 4, to calculate the one-year ahead predicted gross disbursement figures. The predicted net disbursements used in this study are constructed as the difference between one-year ahead predicted gross disbursement and predicted gross principal payment figures. We follow the same method for calculating actual net disbursements as the difference between actual gross disbursements and actual gross principal payments. The new measure of external debt shock is then constructed as the difference between net actual and net predicted disbursements. This measure can simultaneously capture changes in the rate of disbursements and principal payments on existing liabilities, which are both affected by the state of the economy.

The information portrayed by the difference between the actual and predicted series can be used to better foresee episodes of debt distress when this differential is negative, and of sound external sustainability when it is positive. These differences enhance the measurement and the importance of policy interventions especially for negative and large external debt shocks in LMY economies. To illustrate the information portrayed by our constructed measure of external debt shocks, we use two case studies of Haiti during 1997–2018 and Mexico during 1975–2018. Both case studies, enlisted in Appendix C, indicate that our constructed measure serves as a good proxy for the external debt shocks that both countries have experienced.

3. Data

In constructing net disbursement (gross disbursement minus principal payments) annual figures, we use the World Bank's Debtor Reporting System (DRS) database, which collects external debt information at a loan level for 120 developing countries during 1975–2018 (World Bank, 2019). According to the World Bank's operational policy 14.10, DRS member countries are economies having a balance or potential borrowing with the World Bank. Reporting is required regardless of the income classification of the country and is mandatory till this balance gets completely paid off. Data reported from DRS countries gets updated in the internal database, while data for LMY countries gets published in aggregate form in the International Debt Statistics (IDS) and World Development Indicators (WDI) publications.

⁶ Derivations of the external sector debt dynamics are provided in Appendix A. Note, in our empirical estimation we use a slightly different version than the external debt identity expressed in Eq. (1), because we need to account for the equity-creating flows of FDI and portfolio investment, which can also be used to finance current account deficits. IMF's DSA external debt template subtracts these equity flows from the changes in the debt ratio in order to make the external debt identity hold. Our empirical analysis uses both Public and Publicly Guaranteed and Private Non-Guaranteed external debt loan level data, and evaluates the influence of FDI and portfolio equity inflows on external debt shocks by including them as control variables in the regression.

The WDI database is the source of the GDP and Official Development Assistance (ODA) data. This source is used as it provides data for the longest time period available: it goes as far back with historical data as the year 1960 and is up to date with 2018 figures. Current account balance and foreign direct investment data are sourced from IMF's Balance of Payments (BoP) Statistics database, and gap-filled with data from the United Nations Conference on Trade and Development (UNCTAD). Data for personal remittances and income are also sourced from the BoP and gap-filled with country data. IMF's World Economic Outlook (WEO) database is the source for inflation and taxation, while the International Financial Statistics (IFS) database is the source for international reserves and exchange rates.

4. Construction of external debt shocks

In calculating the predicted loan-level disbursements, we focus mostly on long-term loans received by (1) the public sector such as all levels of government, public corporations, and development state banks and (2) the publicly guaranteed sector defined as the private sector guaranteed by the public sector (representing contingent liabilities of the government and public sector). The disbursement profiles used to construct the predicted disbursement depend on the actual terms of each individual loan and are created based on the combination of five main components of each loan: (1) creditor country- DAC, OPEC or former Eastern Bloc member countries, (2) type of creditor- multilateral, bilateral, bonds, suppliers credit, financial institution, etc., (3) years to maturity, (4) purpose code- aid, debt relief and reorganization, infrastructure, etc., and (5) grant element- calculated as the face values minus the sum of the discounted future debt-service payments expressed as a percentage of the loan's face value. The DRS system has constructed twenty-nine different disbursement profiles based on different combinations of these five categories. After constructing one-year ahead predicted disbursements at the loan level, we aggregate these disbursements at the debtor country level.

Furthermore, we construct one-year ahead predicted principal payment figures based on the actual terms of each individual loan, by controlling for the first and last principal payment dates and periodicity of these payments. We then aggregate these predicted principal payments at the debtor country level. This information on payment is important because, when a country is facing a debt crisis, it can slow down payments on its external liabilities and start accumulating arrears.

We use net disbursement on external debt loans from all creditors defined in the DRS database. This measure includes all public and publicly guaranteed long-term debt liabilities reported at a loan-level basis that are composed of obligations from all official and private creditors; see Fig. 1. Actual net disbursements of these loans are correlated with current macro shocks that the economy is experiencing. To eliminate this correlation with current macro shocks and highlight the predictable variations in net disbursements, we calculate predicted net disbursements for each individual loan instead. While current loan approvals are not related to future economic shocks, it is reasonable to believe that current shocks of the economy can affect future actual disbursements. The use of predicted disbursements rather than actual ones bypasses this problem, as these disbursement profiles are based on current debt obligations and do not incorporate any assumptions about future borrowing. We take this one step further and exclude disbursement of loans committed during that same year, therefore removing the effect that current macroeconomic shocks have on the constructed instrument⁷.

Note that we do not include private non-guaranteed loans reported in an aggregate form to the DRS system. Loan data for this sector of the economy cannot be reported at the instrument level, making the construction of predicted disbursements for these loans impossible. However, we make full use of the loan-level information of this database and supplement the private non-guaranteed loans data with bond information of the private non-guaranteed sector, which gets recorded at the instrument level in the DRS dataset. This way we account not only for the behavior of the public sector, but also for movements of the private sector of the economy.

We construct the measure of external shocks using net disbursements on external borrowing, further adjusted for price movements over time by the GDP deflator. Fig. 2 illustrates the elements and shows how the new measure is being constructed.⁸

$$SD_{i,t} = \frac{\frac{ActualDisb_{i,t}}{GDP_deflator_{i,t}} - \frac{PredictedDisb_{i,t}}{GDP_deflator_{i,t}}}{realGDP_{i,t-1}} \quad (2)$$

$$Shock_{i,t} = s_i^g * SD_{i,t} \quad (3)$$

In Eq. (2), we remove predictable variations in external debt disbursements, by subtracting the growth rate of *predicted* gross disbursements from *actual* gross disbursement debt data at time t . This differential is further scaled by the lagged real GDP, and is referred to as the Scaled Difference (SD). Following Auerbach and Gorodnichenko (2017), we compute the average share of actual net disbursements in GDP over the sample period of each country, and multiply this share by the calcu-

⁷ The assumptions of this methodology are in line with Kraay (2012, 2014), the only prior study using the DRS loan-level external debt data to explore the government spending multipliers in developing economies.

⁸ Appendix B illustrates a variation in the calculation of the measure of external debt shocks. This alternate measure has an almost perfect correlation with our constructed measure, except for a few countries which have experienced periods of super-inflation like Argentina, Bolivia and Peru. Consequently, the constructed measure used in the rest of this paper is superior for these countries and performs better during these distortionary periods.

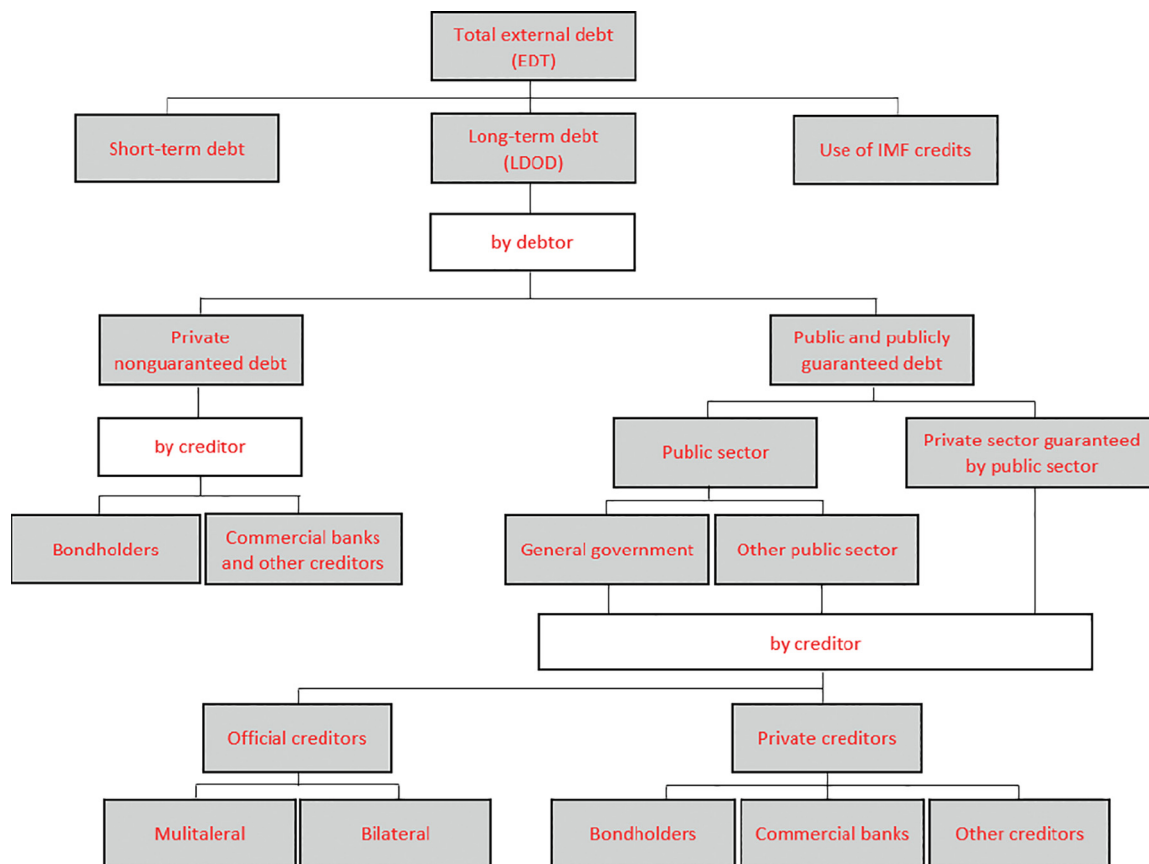


Fig. 1. External Debt and its Components. *Source: International Debt Statistics 2020 (World Bank, 2020) publication.

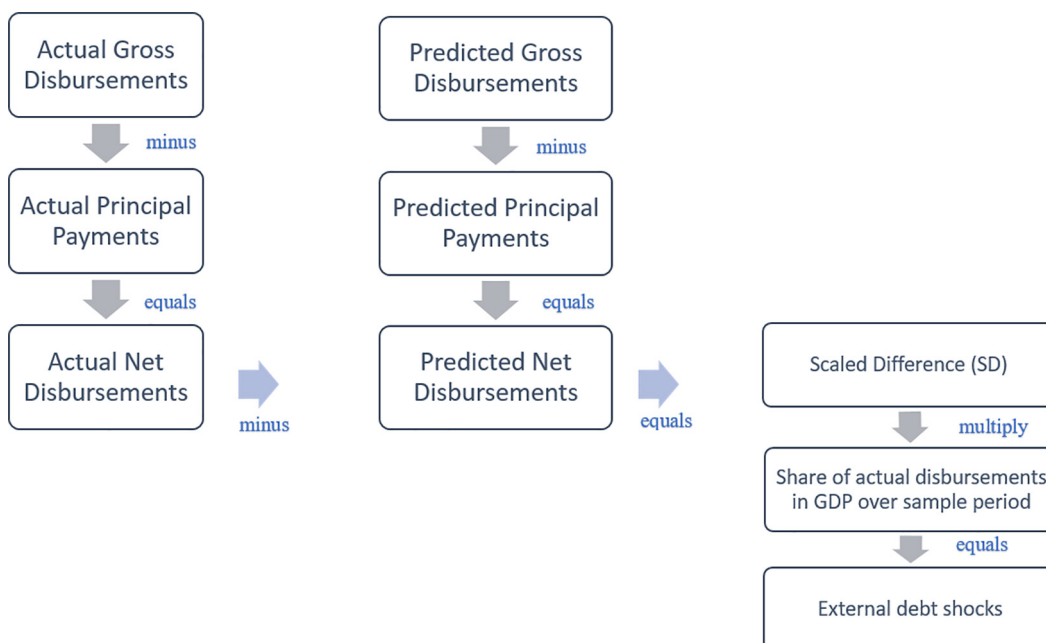


Fig. 2. Illustration of External Debt Shock Construction. *(All variables are expressed as constant local currency price changes scaled by lagged GDP).

lated scaled difference in order to compute the measure of external debt shocks as shown in Eq. (3). Our construction of the shock is in line with Ramey (2011), and Auerbach and Gorodnichenko (2012) where they use differences in predicted spending made by professional forecasters and actual spending to construct a series of unanticipated fiscal shocks.

The unexpected debt shocks can take either positive or negative values as they depend on the difference between actual and predicted net disbursements. The net disbursement values are affected through two channels, namely gross disbursement and gross principal repayment figures. By construction, predicted gross disbursements and principal repayments are calculated at the loan level and remain fixed for each loan. Therefore, changes in the behavior and sign of external debt shocks are solely due to the movements in the actual figures of disbursements and principal payments.

Consequently, a negative debt shock is experienced when actual gross disbursements are lower than predicted ones or when actual principal payments are higher than predicted ones. Lower actual gross disbursements can be experienced when a country loses access to external financial markets, as the government's credibility to repay obligations plummets. Financial markets are highly sensitive to credibility problems, and reputational risks adversely affect the willingness to lend to countries experiencing financial distress. During these periods of distress, countries try to pay off their high interest charging liabilities, leading to an increase in the actual principal payments in an effort to increase the fiscal space available to them and restore credibility in the international markets.

On the other hand, a positive debt shock occurs when actual net disbursements are higher than predicted ones. During these periods, countries are able to sustain their reputation as a credible borrower in order to leverage financial markets. Actual gross disbursements are higher since new disbursements are used to finance development projects in LMY countries. During expansions, principal repayment figures will not be affected as external borrowing of LMY countries is generally concessional in nature with favorable extended terms of financing provided at a rate lower than the market.

Two potential concerns arise with our definition. First, the constructed shock measure might be correlated with other macroeconomic variables. Second, changes in the measure might simply reflect the movement of the noise. To address the first concern, we regress external debt shocks on the lagged values of macroeconomic variables that potentially affect the debt sustainability, including non-interest current account balance, external debt stock, the demeaned growth rate, international reserves, personal remittances and inflows of foreign direct investments. We find that none of these variables are significantly correlated with the constructed shock measure.

To address the second concern, we restrict attention to "large" shocks as a robustness check. Large shocks take on only values of the defined external shock that surpass or fall below its mean by the value of one standard deviation. We do not put a criterion on the number of consecutive years over which the shock is experienced, as debt distress periods can vary in their duration. This specification is clearly in line with the DSA methodology, which has recently refocused on large upfront financing disbursements (IMF & World Bank, 2017). We find that our empirical results shown in Section 6 still hold with or without the restriction imposed on the size of the shock, though the impact of external debt shocks is greater for larger shocks.

5. Model specification

We use the local projection method of Jorda (2005) to assess the effect of external debt shocks on the economic activity of LMY countries. Using local projections is advantageous due to the ease of accommodating flexible specifications, country-dependent responses or possible nonlinear effects. In our exercise, the local projection starts in year 0, the year when the external debt shock is assumed to happen, and the impact of the shock goes up to 5 years, with deviations from year 0 being shown, in addition to the average effect over these 5 years; see also Jorda and Taylor (2016).

5.1. Baseline linear specification

The linear specification of the baseline scenario in Eq. (4) estimates the effect of external debt shocks on changes in the external indebtedness of LMY countries.

$$EDS_{i,t+h} = \sum_{k=0}^K \phi_k^{(h)} shock_{i,t-k} + \sum_{k=1}^K \psi_k^{(h)} EDS_{i,t-k} + \sum_{k=1}^K \beta_k^{(h)} X_{i,t-k} + \alpha_i^{(h)} + \kappa_i^{(h)} + \varepsilon_{i,t+h} \quad (4)$$

Here, EDS represents the change in external debt scaled by lagged GDP, and $shock$ is the constructed measure of external debt shock. We account for a vector of controls X , which includes GDP growth rate, the non-interest current account balance, inflation, international reserves, personal remittances and foreign direct investment equity inflows, in addition to the lagged value of external debt stock. All variables are measured as growth rates to lagged GDP ratio, except for inflation rates, throughout the rest of the paper; see Table 1 for a summary. We check the correlations across the variables and find the highest correlation to be about 0.40 between the demeaned growth rate and its lagged value. We also include country and year fixed effects in the model specification, and use the Driscoll-Kraay (1998) standard errors to control for the possible correlation of the error term over time and across countries.

Table 1
Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
External shock	4156	0	0.001	-0.027	0.017
GDP growth	4310	0.038	0.059	-0.502	0.89
External debt to GDP*	4070	0.024	0.156	-2.01	3.51
Remittances to GDP*	3468	0.003	0.016	-0.128	0.184
Current Acc. to GDP*	3971	-0.002	0.065	-0.855	0.546
FDI equity inflows to GDP*	3939	0.002	0.037	-0.494	0.938
Reserves to GDP*	3604	0.009	0.038	-0.263	0.363

*Variables are measured as growth rates to lagged GDP.

5.2. Non-linear specification accounting for the state of the business cycle

In addition to the baseline linear specification, we further account for the state of the business cycle measured by $F(z_{it})$, where $F(z_{it}) = \exp(-\gamma z_{it}) / (1 + \exp(-\gamma z_{it}))$, and $F(z_{it})$ represents the probability of the economy being in a recession. Following Auerbach and Gorodnichenko (2016), we specify z_{it} as the deviation of GDP from its trend GDP^{trend} :

$$z_{it} = \left(GDP_{it} / GDP_{it}^{trend} \right) / \sigma_i \tag{5}$$

$$\sigma_i = std \left(\log \left(GDP_{it} / GDP_{it}^{trend} \right) \right) \tag{6}$$

We construct the trend using the Hodrick-Prescott filter with a high smoothing parameter of $\lambda = 10,000$. For variations in z_{it} to be comparable across countries, deviations from the trend are normalized to have unit variance and the same value of $\gamma = 1.5$ is applied in the transition function for all countries. Equation (7) presents this nonlinear specification:

$$EDS_{i,t+h} = \sum_{k=0}^K \phi_k^{(h)} shock_{i,t-k} + \sum_{k=1}^K \psi_k^{(h)} EDS_{i,t-k} + \sum_{k=1}^K \beta_k^{(h)} X_{i,t-k} + \sum_{k=0}^K \delta_k^{(h)} shock_{i,t-k} \\ \times F(z_{i,t}) + \sum_{k=1}^K \eta_k^{(h)} EDS_{i,t-k} \times F(z_{i,t}) + \sum_{k=1}^K \mu_k^{(h)} X_{i,t-k} \times F(z_{i,t}) + \pi \times F(z_{i,t}) + \alpha_i^{(h)} + \kappa_i^{(h)} + \varepsilon_{i,t+h} \tag{7}$$

From this specification, the estimated impulse responses are given by $\left\{ \hat{\phi}_0^{(h)} \right\}_{h=0}^H$ in expansions, and by $\left\{ \hat{\phi}_0^{(h)} + \hat{\delta}_0^{(h)} \right\}_{h=0}^H$ in recessions.

6. Impact of external debt shocks

In this section we first present the baseline results estimated using Eq. (4), and the extended results using Eq. (7). We then explore the impact of external debt shocks on external debt to GDP ratio, by considering the state of the business cycle and the level of countries' external indebtedness.

6.1. Linear and non-linear specifications during business cycles

Changes in external debt stock have been a core measure in the DSA methodology and in the literature to assess the external vulnerability of a country. We start by first analyzing the impact at a particular year and 5-year average effect of external debt shocks on the external debt to GDP ratio in LMY economies. Specifically, the dependent variable in Table 2 is the ratio of change in external debt stock to lagged GDP. Changes in this ratio seem to positively affect the external indebtedness of a country in booms as well as in slumps, while the demeaned growth rate of the economy has a negative effect on this ratio.

In the baseline scenario, we control for the lagged value of GDP growth, as negative growth surprises have been identified as the main factor derailing fiscal consolidations (Mauro and Villafuerte, 2013), and changes in external debt, current account balance, international reserves, inflows of personal remittances and equity inflows of foreign direct investment, all scaled by the lagged value of nominal GDP. These control variables have been extensively used in the DSA analysis and in the literature on external debt crises, since they serve as important proxies for flows entering the economy and highlight the capacity of a country to repay its debt obligations. Table 2 presents the results estimated via the baseline linear and extended nonlinear scenarios, and Fig. 3 and shows the impulse response functions (see Fig. 4).

We find that external debt shocks negatively affect the debt to GDP ratio in the linear specification and during booms, while the effect becomes significantly positive during slumps. These findings imply that during expansions, the reliance of an economy on external debt as a source of financing declines. In contrast, an economy during recessions heavily relies on external debt financing. Depending on the initial starting point of the debt-to-GDP ratio, the debt burden of LMY countries

Table 2
Impact of Shocks on External Debt Stock to GDP.

	Year 1			Year 5			Avg. 5		
	Linear	Boom	Slump	Linear	Boom	Slump	Linear	Boom	Slump
External Debt Shocks	-4.161** (1.755)	-12.588* -6.649	20.054 -16.769	-2.542 (2.909)	-21.615*** -6.496	32.065** -12.355	-9.496** (3.952)	-22.492** -9.12	34.392+ -21.914
Lagged external debt stock	0.065* (0.033)	0.095 -0.073	-0.12 -0.101	0.048 (0.034)	0.07 -0.065	-0.08 -0.098	0.051+ (0.034)	0.082 -0.066	-0.095 -0.102
Demeaned growth rate	-0.132* (0.069)	-0.002 -0.173	-0.042 -0.295	-0.118+ (0.077)	0.02 -0.21	-0.072 -0.338	-0.127+ (0.077)	0.008 -0.212	-0.06 -0.344
Lagged demeaned growth rate	-0.005 (0.059)	-0.01 -0.134	-0.258 -0.347	-0.014 (0.068)	0.052 -0.161	-0.437 -0.438	-0.006 (0.068)	0.068 -0.16	-0.457 -0.435
Current account balance	-0.001 (0.001)	0.066* -0.037	-0.240* -0.141	0 (0.005)	0.112** -0.05	-0.381** -0.178	0.001 (0.005)	0.112** -0.049	-0.380** -0.175
FDI equity inflows	-0.339* (0.174)	0.01 -0.198	-0.362 -0.742	-0.376** (0.180)	-0.075 -0.196	-0.492 -0.835	-0.372** (0.174)	-0.148 -0.208	-0.395 -0.847
International reserves	0.369*** (0.077)	-0.252 -0.232	0.864** -0.323	0.385*** (0.086)	-0.409** -0.193	1.106*** -0.288	0.376*** (0.087)	-0.426** -0.197	1.132*** -0.289
Personal remittances	0.569** (0.236)	1.361* -0.798	-2.092* -1.138	0.734*** (0.248)	1.966* -0.986	-2.788* -1.524	0.720*** (0.240)	2.029** -0.95	-2.878* -1.464
constant	0.079*** (0.004)	0.037 -0.029	0.037 -0.029	0.080*** (0.005)	0.056*** -0.012	0.056*** -0.012	0.082*** (0.005)	0.056*** -0.012	0.056*** -0.012
Obs.	2713	1478	1478	2347	1216	1216	2347	1216	1216

Notes: Dependent Variable: Change in external debt to lagged GDP. Country and year fixed effects are included in the regression and the Driscoll-Kraay (1998) standard errors are reported in the parenthesis.

+ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

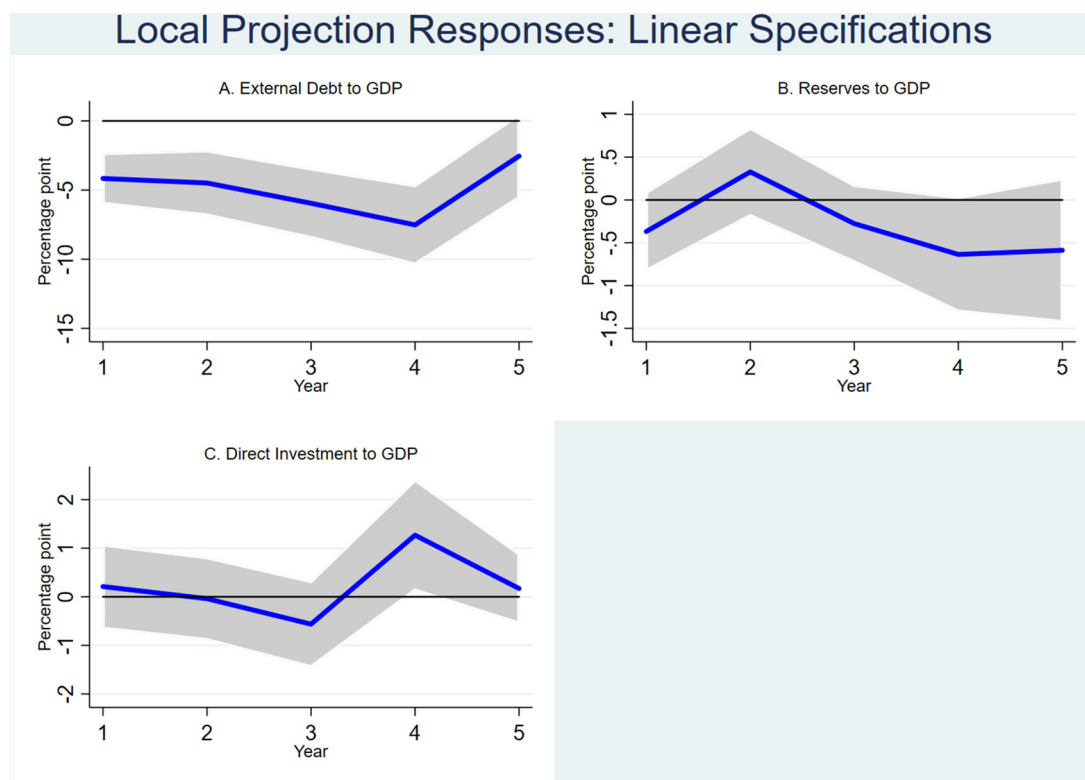


Fig. 3. Response to External Debt Shocks, Linear Specification. *Note: 90% Confidence bands are constructed using Driscoll-Kraay standard errors.

could become unsustainable at a very fast pace. These results support the argument that excessive reliance on debt financing may increase not only a country's actual, but also its perceived vulnerability to shocks (Lane and Milesi-Ferretti, 2017).

Turning to control variables, changes in the current account to GDP ratio may prompt sharp capital flows in and out of the country, as well as affect the external debt stock through the external debt sustainability identity. Large current account def-

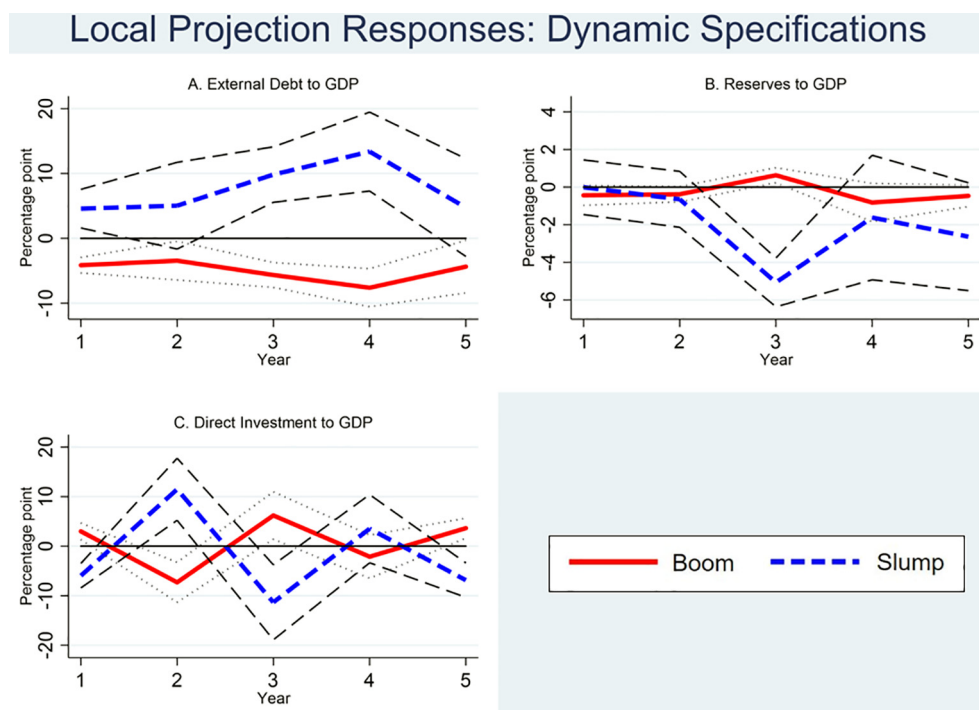


Fig. 4. Response to External Debt Shocks, Dynamic Specification. *Note: 90% Confidence bands are constructed using Driscoll-Kraay standard errors.

icits can limit the ability of countries to have access to external credit, especially during times of financial distress or in the presence of higher interest rates abroad that could possibly trigger sharp capital outflows (IMF & World Bank, 2017). According to our estimation, an increase in the non-interest current account ratio negatively affects the debt to GDP ratio in the linear specification and during slumps. The intuition is straightforward. From the external debt sustainability identity, an increase in the current account balance decreases the need for external financing of a country. During periods of booms, countries have access to other sources of external financing like foreign direct investment and portfolio equity flows, thus explaining the positive effect. By contrast, during periods of economic downturn, an increase in the current account balance (i.e. a deficit decrease) negatively affects the debt-to-GDP ratio and consequently, positively affects the external debt sustainability of an economy.

Another important variable in capturing the vulnerability of an economy to adverse shocks is the international reserves, since the country is perceived as having the ability to quickly adjust if it suddenly loses access to external borrowing. We account for changes in international reserves and find the supporting evidence. Specifically, increases in the international reserves are positively related to external debt in the linear specification as well as during slumps. This result is in line with the literature that sees reserves as a lender of last resort facility in central banks and associates higher reserve accumulations with pre-crisis periods, in order for countries to achieve higher post-crisis GDP growth (Dominguez et al., 2012).

Additionally, Dominguez et al. (2012) show that once reserves fall below the threshold, debt rollover and capital flight problems can erupt due to sudden stops in new capital inflows. Consequently, we also account for the effect that equity inflows of foreign direct investment (FDI) have on external debt stock, and find that an increase in equity inflows of FDI have a negative effect on external debt stock in the linear specification.

Finally, we include changes in inflows of personal remittances to lagged GDP ratio, measured as the sum of compensation of employees and personal transfers. A rise in inflows of personal remittances increases external debt in the linear specification and during booms, while decreases external debt during slumps. The switching sign of the coefficients during booms and slumps highlights the countercyclical effect of flows of remittances with respect to income in the worker's country of origin, i.e. the recipient of the remittance (Frankel, 2011). Inflows of personal remittances serve as buffers and tend to increase during slumps in the home country. The economic significance of the effect of remittances on the debt-to-GDP ratio is of particular interest, since it has the strongest effect among the control variables in this assessment.

We repeat this exercise with large external debt shocks only and report the results in Table 3. As expected, the impact becomes much larger. The debt to GDP ratio more than doubles when the economy gets hit by large negative external shocks during recessionary periods, compared to the effect of large positive shocks during expansions. These results strongly suggest that large, negative external debt shocks could serve as predictors for external debt distress.

Table 3
Impact of large shocks on the external debt to GDP ratio.

	Year 1		
	Linear	Boom	Slump
External Debt Shocks-Banded	-3.55 (2.596)	-33.779*** -11.572	69.474** -26.321
Lagged external debt stock	-0.017 (0.072)	-0.381 -0.522	-0.025 -0.641
Demeaned growth rate	-0.408*** (0.138)	-0.304 -0.611	0.536 -0.979
Lagged demeaned growth rate	-0.18 (0.199)	-0.687 -0.706	1.203 -0.883
Current account balance	-0.002** (0.001)	-0.096 -0.178	0.369 -0.676
FDI equity inflows	0.453+ (0.276)	0.047 -1.665	1.431 -2.419
International reserves	0.566* (0.311)	0.211 -0.755	0.351 -1.095
Personal remittances	1.434* (0.784)	-2.563* -1.363	11.485** -4.506
Constant	0.079*** (0.015)	0.244*** -0.072	0.244*** -0.072
Obs.	259	154	154

Notes: Dependent Variable: Change in external debt/lagged GDP. We identify large external debt shocks as the values of those shocks that surpass or fall below the mean plus/minus one standard deviation. Country and year fixed effects are included in the regression and the Driscoll-Kraay (1998) standard errors are reported in the parenthesis.
+ p < 0.15, * p < 0.10, ** p < 0.05, *** p < 0.01.

6.2. Non-linear specification accounting for the level of indebtedness

While accounting for the state of the business cycle is important when evaluating the elements that affect debt sustainability, the evaluation cannot be complete without taking into consideration the initial levels of external indebtedness of LMY economies. The levels of external indebtedness have been on the rise since the 2008 crisis and consequently economies have less fiscal space and face increasing borrowing costs on their existing obligations. Accordingly, we account for the debt burden of LMY economies by focusing on external debt variations within the countries as follows:

$$D_{i,t}^* = \frac{D_{i,t} - D_i^{min}}{D_i^{max} - D_i^{min}} \tag{8}$$

Here, $D_{i,t}$ is the debt-to-GDP ratio for country i at time t , and D_i^{max} and D_i^{min} are the maximum and minimum values of the ratio over the sample period. $D_{i,t}^*$ varies between 0 and 1 for all countries to ensure cross-country comparability. In equation (9), estimates of $\left\{ \hat{\phi}_0^{(h)} \right\}_{h=0}^H$ provide impulse responses for low-levels of the external debt variable, while estimates of $\left\{ \hat{\phi}_0^{(h)} + \hat{\delta}_0^{(h)} \right\}_{h=0}^H$ provide impulse responses for high-levels of the external debt variable.

$$EDS_{i,t+h} = \sum_{k=0}^K \phi_k^{(h)} shock_{i,t-k} + \sum_{k=1}^K \psi_k^{(h)} EDS_{i,t-k} + \sum_{k=1}^K \beta_k^{(h)} X_{i,t-k} + \sum_{k=0}^K \delta_k^{(h)} shock_{i,t-k} \times D_{i,t-1}^* + \sum_{k=1}^K \eta_k^{(h)} EDS_{i,t-k} \times D_{i,t-1}^* + \sum_{k=1}^K \mu_k^{(h)} X_{i,t-k} \times D_{i,t-1}^* + \pi \times D_{i,t-1}^* + \alpha_i^{(h)} + \kappa_i^{(h)} + \varepsilon_{i,t+h} \tag{9}$$

Results for this specification are presented in Table 4, which are mostly in line with the findings in the previous section. The linear effect of a shock on the debt to GDP ratio is negative, suggesting external debt shocks as a reliable source of financing. Following the shock, the ratio decreases much more when the economy is in the high debt state. The coefficients on control variables take the expected sign. For example, an increase in the demeaned growth rate causes a decrease in the debt to

Table 4
Impact of shocks on external debt to GDP in high and low debt levels.

	Year 1			Year 5			Avg. 5		
	Linear	Low Debt	High Debt	Linear	Low Debt	High Debt	Linear	Low Debt	High Debt
External Debt Shocks	-4.161** (1.755)	0.104 -6.618	-3.204 -8.278	-2.542 (2.909)	4.598 -12.336	-8.213 -15.792	-9.496** (3.952)	-1.071 -10.264	-4.732 -12.545
Lagged external debt stock	0.065* (0.033)	0.081 -0.066	-0.049 -0.1	0.048 (0.034)	0.037 -0.074	0.01 -0.112	0.051+ (0.034)	0.033 -0.069	0.017 -0.106
Demeaned growth rate	-0.132* (0.069)	0.157+ -0.095	-0.671*** -0.221	-0.118+ (0.077)	0.180+ -0.116	-0.720*** -0.249	-0.127+ (0.077)	0.181* -0.106	-0.723*** -0.24
Lagged demeaned growth rate	-0.005 (0.059)	-0.027 -0.074	-0.029 -0.196	-0.014 (0.068)	0.007 -0.076	-0.122 -0.188	-0.006 (0.068)	0.013 -0.077	-0.131 -0.194
Current account balance	-0.001 (0.001)	0.012** -0.005	-0.261** -0.12	0 (0.005)	0.012*** -0.003	-0.424*** -0.154	0.001 (0.005)	0.011*** -0.002	-0.408** -0.157
FDI equity inflows	-0.339* (0.174)	-0.325* -0.191	0.246 -0.707	-0.376** (0.180)	-0.27 -0.229	-0.026 -0.79	-0.372** (0.174)	-0.27 -0.225	-0.008 -0.79
International reserves	0.369*** (0.077)	-0.124 -0.143	1.494*** -0.406	0.385*** (0.086)	-0.205 -0.157	1.781*** -0.408	0.376*** (0.087)	-0.209 -0.155	1.774*** -0.408
Personal remittances	0.569** (0.236)	-0.221 -0.49	2.090* -1.229	0.734*** (0.248)	-0.237 -0.593	2.502* -1.367	0.720*** (0.240)	-0.234 -0.583	2.476* -1.366
constant	0.079*** (0.004)	0.030* -0.015	0.030* -0.015	0.080*** (0.005)	0.037*** -0.013	0.037*** -0.013	0.082*** (0.005)	0.029* -0.016	0.029* -0.016
Obs.	2713	2713	2713	2347	2347	2347	2347	2347	2347

Notes: Dependent Variable: Change in external debt/lagged GDP. Country and year fixed effects are included in the regression and the Driscoll-Kraay (1998) standard errors are reported in the parenthesis.

+ p < 0.15, * p < 0.10, ** p < 0.05, *** p < 0.01.

GDP ratio, while the current account has a negative effect during periods of low debt, but a positive one during high debt periods. An increase in international reserves during periods of low debt lowers the debt to GDP ratio, while this effect increases the debt to GDP ratio during periods of high debt by a sizable 1.7 percentage points at one-year ahead.

6.3. Non-linear specification accounting for both the level of indebtedness and state of the business cycle

Furthermore, we introduce an additional modification to differentiate between the variation in responses due to the state of the economy and the level of external debt. In this specification, the response of the debt to GDP ratio during periods of expansion and low debt is expressed by $\left\{ \hat{\phi}_0^{(h)} \right\}_{h=0}^H$, and by $\left\{ \hat{\phi}_k^{(h)} + \hat{\delta}_k^{(h)} + \delta_k^{(h)} + \tau_k^{(h)} \right\}_{h=0}^H$ during episodes of recession and high debt as in Eq. (10):

$$\begin{aligned}
 EDS_{i,t+h} = & \sum_{k=0}^K \phi_k^{(h)} shock_{i,t-k} + \sum_{k=1}^K \psi_k^{(h)} EDS_{i,t-k} + \sum_{k=1}^K \beta_k^{(h)} X_{i,t-k} + \sum_{k=0}^K \tilde{\delta}_k^{(h)} shock_{i,t-k} \times F(z_{i,t}) + \sum_{k=1}^K \tilde{\eta}_k^{(h)} EDS_{i,t-k} \\
 & \times F(z_{i,t}) + \sum_{k=1}^K \tilde{\mu}_k^{(h)} X_{i,t-k} \times F(z_{i,t}) + \sum_{k=0}^K \delta_k^{(h)} shock_{i,t-k} \times D_{i,t-1}^* + \sum_{k=1}^K \eta_k^{(h)} EDS_{i,t-k} \times D_{i,t-1}^* + \sum_{k=1}^K \mu_k^{(h)} X_{i,t-k} \\
 & \times D_{i,t-1}^* + \sum_{k=0}^K \tau_k^{(h)} shock_{i,t-k} \times D_{i,t-1}^* \times F(z_{i,t}) + \sum_{k=1}^K v_k^{(h)} EDS_{i,t-k} \times D_{i,t-1}^* \times F(z_{i,t}) + \sum_{k=1}^K \theta_k^{(h)} X_{i,t-k} \times D_{i,t-1}^* \\
 & \times F(z_{i,t}) + \pi \times D_{i,t-1}^* + \tilde{\pi} \times D_{i,t-1}^* \times F(z_{i,t}) + \tilde{\pi} \times F(z_{i,t}) + \alpha_i^{(h)} + \kappa_i^{(h)} + \varepsilon_{i,t+h}
 \end{aligned} \tag{10}$$

Table 5 presents the results at Year 1 and Year 5, as well as the average over five years. Our estimates clearly illustrate the role of interaction between high debt and the state of the economy. In particular, when high debt is coupled with booms, external debt shocks are significantly negatively related to the debt to GDP ratio, forcing borrowing countries to lower their reliance on external debt financing. At high debt levels during recessions, however, the shocks lead to substantial increase in the ratio, which in turn, might cause economies to go into debt distress situations and therefore, calls for policy intervention to achieve external sustainability.⁹

⁹ We assess and report the impact of external debt shocks on international reserves in Table 6 and on equity flows of FDI in Table 7. The corresponding impulse response functions are plotted in Figs. 3 and 4. As we can see, international reserves are negatively affected by external debt shocks in the linear specification, but positively affected during recessions, highlighting again the offsetting role of international reserves when the access to external financing is lost, and also serving as a signal of pessimism in the accumulation of reserves. External debt shocks have a positive effect on equity inflows of FDI during expansions, but the effect turns out to be negative during recessions, indicating the cyclical nature of these type of financing in LMY economies.

Table 5
Impact of shocks on external debt to GDP by the state of the business cycle and high/low debt levels.

	Year 1					Year 5				
	Linear	boom/ low debt	boom/ high debt	slump/ low debt	slump/ high debt	Linear	boom/low debt	boom/ high debt	slump/ low debt	slump/ high debt
External Debt Shocks	-4.161**	-3.409	-51.783+	-15.586	165.688*	-2.542	-16.410***	-19.183	-1.438	110.922*
	(1.755)	(4.621)	(31.093)	(15.587)	(89.303)	(2.909)	(5.336)	(20.682)	(15.879)	(64.268)
Lagged external debt stock	0.065*	0.159***	-0.505*	-0.135	0.66	0.048	0.165***	-0.461*	-0.233+	0.857*
	(0.033)	(0.058)	(0.270)	(0.119)	(0.468)	(0.034)	(0.050)	(0.255)	(0.153)	(0.462)
Demeaned growth rate	-0.132*	-0.172	0.448	0.504	-1.313	-0.118+	-0.165	0.212	0.495	-0.864
	(0.069)	(0.256)	(0.485)	(0.425)	(0.969)	(0.077)	(0.262)	(0.387)	(0.495)	(1.079)
Lagged demeaned growth rate	-0.005	-0.228	0.475	0.101	-0.766	-0.014	-0.264	0.684	0.193	-1.388
	(0.059)	(0.215)	(0.573)	(0.310)	(1.175)	(0.068)	(0.194)	(0.624)	(0.332)	(1.380)
Current account balance	-0.001	0.079	-0.189	-0.243	-0.423	0	-0.035	-0.985+	0.209	-0.307
	(0.001)	(0.060)	(0.325)	(0.220)	(1.068)	(0.005)	(0.088)	(0.598)	(0.313)	(1.374)
FDI equity inflows	-0.339*	-0.105	0.426	0.392	-2.603	-0.376**	-0.230+	0.346	1.167+	-4.374+
	(0.174)	(0.131)	(1.074)	(0.499)	(2.727)	(0.180)	(0.137)	(0.990)	(0.745)	(2.916)
International reserves	0.369***	-0.303	0.19	0.342	1.630+	0.385***	-0.403+	0.874	0.175	1.515
	(0.077)	(0.225)	(0.489)	(0.390)	(1.036)	(0.086)	(0.251)	(0.828)	(0.582)	(1.744)
Personal remittances	0.569**	0.335	4.895**	-0.01	-8.999**	0.734***	0.786+	4.671**	-1.226	-6.252*
	(0.236)	(0.727)	(2.109)	(1.260)	(3.426)	(0.248)	(0.496)	(1.951)	(0.905)	(3.360)
constant	0.079***	0.039***	0.039***	0.039***	0.039***	0.080***	0.021***	0.021***	0.021***	0.021***
	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)
Obs.	2713	1468	1468	1468	1468	2347	1210	1210	1210	1210
	Avg. 5									
	Linear	boom/low debt	boom/high debt	slump/low debt	slump/high debt					
External Debt Shocks	-9.496**	-8.375+	-85.071*	-34.994	303.756**					
	(3.952)	(5.012)	(44.121)	(25.460)	(137.555)					
Lagged external debt stock	0.051+	0.173***	-0.441*	-0.207+	0.788*					
	(0.034)	(0.049)	(0.260)	(0.135)	(0.451)					
Demeaned growth rate	-0.127+	-0.226	0.401	0.559	-1.115					
	(0.077)	(0.284)	(0.429)	(0.518)	(1.119)					
Lagged demeaned growth rate	-0.006	-0.246	0.687	0.2	-1.409					
	(0.068)	(0.221)	(0.672)	(0.356)	(1.437)					
Current account balance	0.001	-0.023	-0.967+	0.164	-0.303					
	(0.005)	(0.083)	(0.612)	(0.294)	(1.376)					
FDI equity inflows	-0.372**	-0.309**	0.382	1.184*	-4.399+					
	(0.174)	(0.145)	(1.065)	(0.689)	(2.886)					
International reserves	0.376***	-0.417*	0.671	0.259	1.672					
	(0.087)	(0.246)	(0.803)	(0.560)	(1.741)					
Personal remittances	0.720***	0.934*	4.176**	-1.439+	-5.540+					
	(0.240)	(0.494)	(1.932)	(0.910)	(3.412)					
constant	0.082***	0.027***	0.027***	0.027***	0.027***					
	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)					
Obs.	2347	1210	1210	1210	1210					

Notes: Dependent Variable: Change in external debt/lagged GDP. Country and year fixed effects are included in the regression and the Driscoll-Kraay (1998) standard errors are reported in the parenthesis.

+ p < 0.15, * p < 0.10, ** p < 0.05, *** p < 0.01.

7. Conclusions

Indebtedness of developing economies has reached new highs in 2018 since the global financial crisis, due to easy access to sources of external finance as well as extremely favorable borrowing conditions. This upward trend has, however, raised serious concerns, because elevated levels of indebtedness would jeopardize the growth prospects of LMY economies. Debt insolvency is costly and can result in allocation of resources from the long-term to the short term, and to different sectors of the economy. Additionally, non-repayment of obligations or delays could result in reputational risk for the debtor country, and limit access to new financing options and market resources. Proper and timely identification of debt distress signals cannot be overemphasized. For this purpose, we construct new measures of external debt shocks that the economy might be experiencing based on the loan level data. To identify exogenous shocks, we utilize the difference between actual and pre-

Table 6
Impact of external debt shocks on international reserves.

	Year 1			Year 5			Avg. 5		
	Linear	Boom	Slump	Linear	Boom	Slump	Linear	Boom	Slump
External Debt Shocks	-0.247 (0.319)	-0.492+ (0.324)	0.939 (1.359)	-0.611 (0.497)	-1.151+ (0.695)	-0.261 (1.895)	-0.899 (0.659)	-2.885** (1.377)	3.09 (2.771)
External debt stock	0.029*** (0.005)	-0.003 (0.028)	0.083+ (0.056)	0.027*** (0.004)	-0.011 (0.032)	0.086 (0.066)	0.027*** (0.004)	-0.016 (0.033)	0.092 (0.067)
Lagged external debt stock	-0.016** (0.008)	-0.055*** (0.014)	0.028 (0.020)	-0.015* (0.007)	-0.054*** (0.017)	0.03 (0.021)	-0.015* (0.007)	-0.055*** (0.017)	0.033+ (0.021)
Demeaned growth rate	0.075*** (0.021)	0.024 (0.063)	0.115 (0.121)	0.065*** (0.021)	-0.005 (0.066)	0.159 (0.138)	0.064*** (0.020)	-0.025 (0.065)	0.19 (0.136)
Lagged demeaned growth rate	-0.029* (0.016)	-0.039 (0.046)	0 (0.083)	-0.024+ (0.016)	-0.02 (0.046)	-0.038 (0.085)	-0.024+ (0.016)	-0.015 (0.048)	-0.045 (0.089)
Current account balance	0.003*** (0.000)	-0.073*** (0.025)	0.282*** (0.096)	0.004* (0.002)	-0.094** (0.032)	0.343*** (0.114)	0.004* (0.002)	-0.091*** (0.032)	0.335*** (0.114)
FDI equity inflows	0.080*** (0.027)	-0.012 (0.051)	0.267*** (0.097)	0.071** (0.028)	-0.001 (0.058)	0.250** (0.117)	0.071** (0.027)	0.019 (0.060)	0.216* (0.121)
Personal remittances	0.170*** (0.061)	0.081 (0.153)	0.173 (0.383)	0.157** (0.065)	0.057 (0.180)	0.151 (0.459)	0.156** (0.065)	0.045 (0.174)	0.163 (0.451)
constant	0.016*** (0.001)	0.014*** (0.004)	0.014*** (0.004)	0.017*** (0.001)	0.013*** (0.003)	0.013*** (0.003)	0.017*** (0.001)	0.013*** (0.004)	0.013*** (0.004)
Obs.	2713	1478	1478	2347	1216	1216	2347	1216	1216

Notes: Dependent Variable: Change in international reserve/lagged GDP. Country and year fixed effects are included in the regression and the Driscoll-Kraay (1998) standard errors are reported in the parenthesis.

+ p < 0.15, * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 7
Impact of external debt shocks on FDI equity inflows.

	Year 1			Year 5			Avg. 5		
	Linear	Boom	Slump	Linear	Boom	Slump	Linear	Boom	Slump
External Debt Shocks	0.210 (0.832)	1.738 (1.428)	-6.057 (4.540)	0.171 (0.692)	0.560 (1.233)	-2.852 (4.466)	0.257 (1.529)	4.954** (1.921)	-13.159* (7.080)
External debt stock	-0.028 (0.022)	-0.022 (0.067)	0.008 (0.114)	-0.029 (0.021)	-0.064 (0.080)	0.058 (0.132)	-0.028 (0.021)	-0.049 (0.067)	0.036 (0.115)
Lagged external debt stock	-0.008 (0.014)	-0.077** (0.032)	0.173** (0.075)	-0.003 (0.012)	-0.066+ (0.043)	0.160* (0.087)	-0.003 (0.013)	-0.064+ (0.042)	0.157* (0.086)
Demeaned growth rate	0.012 (0.014)	0.096+ (0.064)	-0.206** (0.096)	-0.004 (0.013)	0.049 (0.061)	-0.142+ (0.096)	-0.003 (0.012)	0.071 (0.059)	-0.181* (0.091)
Lagged demeaned growth rate	-0.009 (0.013)	-0.134+ (0.081)	0.257** (0.123)	-0.008 (0.012)	-0.033 (0.058)	0.100 (0.103)	-0.008 (0.011)	-0.050 (0.064)	0.132 (0.115)
Current account balance	-0.001+ (0.001)	0.083** (0.032)	-0.311** (0.122)	-0.004 (0.003)	0.107** (0.041)	-0.385** (0.145)	-0.004 (0.003)	0.105** (0.041)	-0.380** (0.146)
International reserves	0.083*** (0.020)	0.073 (0.109)	0.027 (0.176)	0.076*** (0.023)	0.116 (0.129)	-0.037 (0.210)	0.076*** (0.023)	0.144 (0.121)	-0.078 (0.199)
Personal remittances	0.236 (0.242)	-0.145 (0.324)	0.257 (0.472)	0.320 (0.247)	0.331* (0.181)	-0.348 (0.378)	0.321 (0.247)	0.324* (0.167)	-0.349 (0.351)
constant	0.004** (0.002)	0.025** (0.011)	0.025** (0.011)	0.004** (0.001)	0.030*** (0.009)	0.030*** (0.009)	0.004*** (0.001)	0.026** (0.012)	0.026** (0.012)
Obs.	2713	1478	1478	2347	1216	1216	2347	1216	1216

Notes: Dependent Variable: Change in FDI equity inflows/lagged GDP. Country and year fixed effects are included in the regression and the Driscoll-Kraay (1998) standard errors are reported in the parenthesis.

+ p < 0.15, * p < 0.10, ** p < 0.05, *** p < 0.01.

dicted net disbursement on external debt obligation for each loan and then take aggregation at the country-year level for 120 LMY countries during 1975–2018.

Using the local projection method, we find that the impact of external debt shocks on the debt to GDP ratio varies considerably with the state of the business cycle. During expansionary times, external debt shocks lead to persistent decreases in the external debt to GDP ratio, possibly due to the availability of other sources of financing. During recessionary periods, however, we see heavy reliance on external debt financing for most of developing countries. This reliance is more substantial for countries with higher levels of external debt stock, raising serious concerns for debt distress and external vulnerability.

The new external debt shock measures offer much potential for future research. For example, would large, negative external debt shocks lead to increased income inequality within these LMY countries? What is the impact on global inequality? Our findings also highlight the need for LMY authorities to implement credible measures and ensure that borrowing plans

are in line with stabilizing debt dynamics. With the elevated external debt levels, LMY countries should focus on a set of measures to ensure macroeconomic stability, including external and fiscal consolidation, increased exchange rate flexibility and the removal of current account deficits. Once economic growth begins to slow down, there is high uncertainty on how LMY economies will respond to the elevated levels of external public debt, spreading the risk from the public sector to the whole economy.

Appendix A. Derivations of external sector debt dynamics

Following IMF (2008), the evolution of external debt is represented by:

$$D_{t+1} = (1 + r_f)DF_t + (1 + r_d)(1 + \varepsilon)DD_t - TB_{t+1}$$

Here D_{t+1} is total stock of debt at time t , DF is the portion of total debt denominated in foreign currency, while DD is the portion of total debt denominated in domestic currency, r_f is the foreign interest rates, while r_d is the domestic interest rate, TB_{t+1} is the noninterest current account balance, ε represents the change in exchange rate defined in terms of U.S. dollars per local currency.

When expressing all variables as a proportion of GDP, the above equation can be written as follows:

$$d_{t+1} = \frac{(1 + r_f)}{(1 + g)(1 + \rho)}df_t + \frac{(1 + r_d)(1 + \varepsilon)}{(1 + g)(1 + \rho)}dd_t - tb_{t+1}$$

where ρ is the change in the domestic GDP deflator (π) expressed in U.S. dollar terms and is derived as $\rho = (1 + \pi)(1 + \varepsilon) - 1$. By rearranging the terms, we have:

$d_{t+1}(1 + g + \rho + g\rho) = (1 + r_f)df_t + (1 + r_d)(1 + \varepsilon)dd_t - (1 + g + \rho + g\rho)tb_{t+1}$, or the following expression, when $d_t = df_t + dd_t$:

$$d_{t+1}(1 + g + \rho + g\rho) = d_t + \varepsilon(1 + r_d)dd_t + r_fdf_t + r_ddd_t - (1 + g + \rho + g\rho)tb_{t+1}.$$

Let α be the share of total external debt expressed in domestic currency ($\alpha d_t = dd_t$), and \check{r} be the weighted average of domestic and foreign interest rates, where $\check{r} = \alpha r_f + (1 - \alpha)r_d$. Then we have

$$d_{t+1}(1 + g + \rho + g\rho) = d_t + \varepsilon(1 + r_d)dd_t + \check{r}d_t - (1 + g + \rho + g\rho)tb_{t+1}$$

Finally, we assume that r_f approximately equals \check{r} . Rearranging the terms, the equation used in this study and the DSA analysis can be written as:

$$d_{t+1} - d_t = \frac{1}{(1 + g + \rho + g\rho)}(\check{r} - g - \rho(1 + g) + \varepsilon\alpha(1 + \check{r}))d_t - tb_{t+1}$$

Appendix B. Alternate calculation of the measure of external debt shocks

This appendix presents an alternative but similar measure of external debt shocks. This alternative measure follows the same steps presented in the main text of the paper, besides the calculations of the scaled difference, which gets constructed as the difference between the growth rate of actual net disbursements and the growth rate of predicted net disbursements and is further scaled by the lagged value of nominal GDP.

$$SD_{i,t|t-1} = \frac{\Delta ActualDisb_{i,t} - \Delta PredictedDisb_{i,t}}{Lagged\ Nominal\ GDP_{i,t-1}}$$

$$shock_{i,t} = S_i^g * SD_{i,t|t-1}$$

Following Auerbach and Gorodnichenko (2016), we compute the average share of actual net disbursements in GDP over the sample period of each country and multiply this share by the calculated scaled difference in order to compute the measure of external debt shocks. The constructed scaled differences are still interpreted as the unexpected external debt shocks in developing economies. Additionally, by controlling for the lags of external debt stock and GDP growth, any predictable effect has been removed from the scaled difference.

The correlation of this alternative measure with the external debt shock measure presented in the main text is about 0.93, except for a few countries that have experienced periods of super-inflation like Argentina, Bolivia and Peru. This alternative measure accounts for the inflationary effects that the economy is experiencing and converts the series from nominal to constant values. Our empirical results from the regression analysis are robust to both measures of external debt shocks. Results using the alternative measure in this appendix are available upon request.

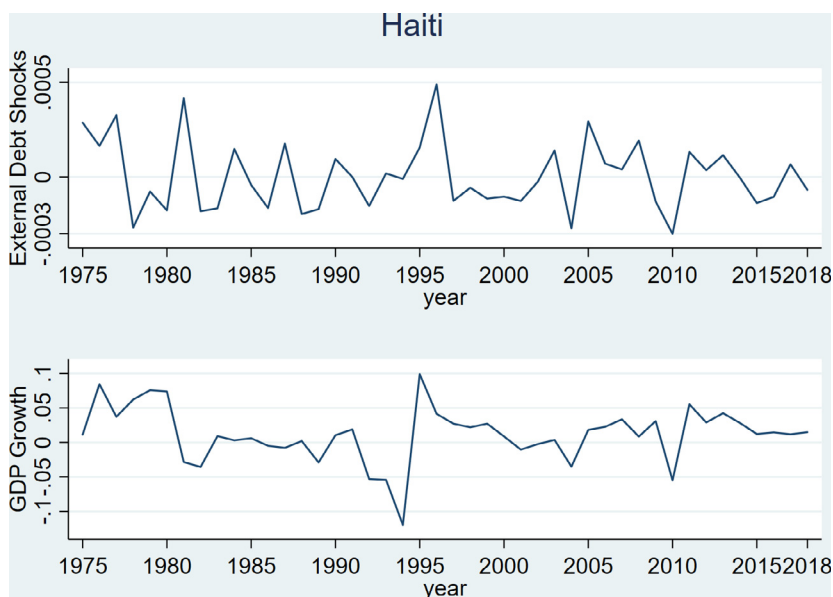


Fig. C1. Haiti's History of Debt Shocks and GDP Growth Fluctuations.

Appendix C. Case studies: external debt shocks measure

Case Study 1: Haiti

Haiti has been characterized as the poorest and most misgoverned country in the Americas which led to the 2004 ousting of President Jean-Bertrand Aristide, Haiti's elected president, by a combination of armed rebellion, popular protest and French and American pressure (the Economist, 2004). The country's rebellion during this period is highlighted by a drop in GDP as well as a drop in the shock measure in 2004. Haiti was then hit in 2008 by global financial crisis, with food prices rising by almost 40% and food riots gripping the country (Ryan and agencies, 2008). The country was then ravaged by a massive earthquake in January of 2010, which tore a catastrophic path of destruction through the country. The severe natural disaster took a toll on the country's GDP and our measure of shocks in 2010 (see Fig. C1). Months after the quake, the country experienced the worst cholera epidemic in the modern world (Cook, 2017).

Haiti's geographical location makes the country prone to national disasters. In 2012 it was hit by hurricane Sandy, while in 2015 the main harvest fell below average with losses of up to 70 percent in some areas due to the El Niño phenomenon (World Food Programme, 2016). This served as a severe blow to food security in Haiti, where agriculture employs half of the working population and 75 percent of people live on less than US\$2 per day (World Food Programme, 2016). The 2015 hit was portrayed by a drop in both the GDP growth and external debt shock measure, which were on the upward trajectory in 2016.

Case Study 2: Mexico

Fig. C2 presents an illustration of the constructed measure of external debt shocks for Mexico as well as the GDP growth trends covering the time period 1975–2018. Mexico has a long history of economic meltdowns. From April 1954 until September of 1976, Mexico maintained a fixed exchange rate regime pegged to the U.S. dollar. Increased inflationary pressure, a slowdown in growth of the economy, and rising public sector deficits caused the devaluation of the peso by more than 50% as the country switched its exchange rate regime from a fixed to a managed floating one in 1976 (Banco de Mexico, 2009). Mexico reached an agreement with the IMF in 1977 and was assisted during this time period via the Extended Fund Facility (IMF, 2015).

In 1979, the portion of export receipts absorbed by debt service reached a peak of 68 percent, but since the country's magnitude of oil reserves had just become known, Mexico's growth prospects were no longer seen as limited and the authorities embarked in a massive fiscal expansion (Boughton, 2001). As indicated in the graphs by the increase in the GDP growth rate and the measure of shock in the country during 1979–1981, Mexico's economy was booming and experiencing higher growth, lower inflation and current account deficit due to the country's oil discoveries combined with the persistence of high oil prices.

This period of boom turned into a bust when oil prices began falling in 1981 and U.S. short interest rates increased (Gould, 1995). In 1982, the peso was devalued by 260%, inflation reached 100%, the banking system was nationalized, and all trade

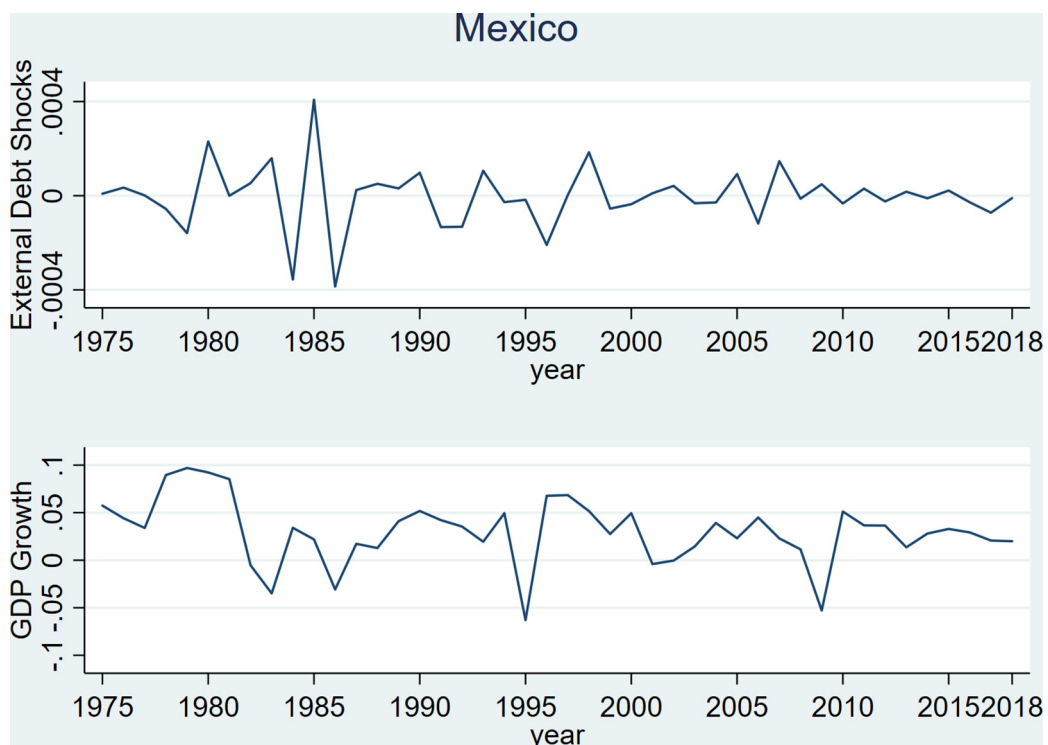


Fig. C2. Mexico's History of Debt Shocks and GDP Growth Fluctuation.

became regulated. Both panels of Fig. C2 indicate a sharp fall starting in 1982, the brief improvements in both measures as efforts are being made to stabilize the economy, and the fall of 1986 as inflation accelerated again to 100% and was followed by a stock market crash in 1987 (Gould, 1995).

Mexico became the first nation to negotiate with the Bank Advisory Committee representing the commercial bank creditors in 1982 and agree to restructure its debt under the Brady Plan in 1989–1990, a period associated with structural reform, deregulation, trade liberalization, bank privatization and cuts in public spending (van Wijnbergen et al., 1991). While these measures seemed to initially benefit the economy by lowering inflation and increasing growth, signs of trade disequilibrium started to emerge, growth slowed down and the current account deficit reached \$29 billion in 1994 (WDI, 2018). In 1994, maintenance of the fixed exchange rate dried the reserves, while political instability added to the uncertainty in the country. Consequently, Mexico switched to a floating exchange rate regime in December 1994 (Banco de México, 2009). The recession that followed due to the peso depreciation, capital outflows and bank crises of 1995 and 1997 is evidenced in both panels of Fig. C2 with a drastic drop in GDP growth and the external debt shock measure during this time period.

Since the switch to a floating exchange rate and the economic bailout, the Mexican economy has been relatively stable as GDP growth and inflows of foreign direct investment increased in the country. Mexico was negatively affected by the 2008 financial crisis as evidenced by the drop in GDP growth and shock measure in Fig. C2. The economy has been relatively stable following the recovery from the crisis.

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