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DEBT SUSTAINABILITY AND MONETARY POLICY ATTAINMENT IN EMEs

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Debt Sustainability and Monetary Policy Attainment in EMEs*

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Abstract

We explore the link between debt sustainability and monetary policy attainment in a set of EMEs. To that end, we consider how the primary balance responds to changes in debt. We first estimate a set of panel data regressions using different controls, in which we group the economies depending if their average inflations are above or below a threshold. We divide the EMEs depending if they have had a currency, banking, external or internal debt crisis. In general, we find that EMEs with a shoddier inflation record or those that have had one or more of the mentioned crisis episodes, have primary balance that reacts more markedly to changes in the debt level. In addition, their primary balances depend negatively on the inflationary component, and depend positively on their current accounts, reflecting the twin-deficit phenomena. As a corollary, those groups that have had a better macroeconomic record could have higher sustainable levels of debt in the long term. Nonetheless, this does not mean that those EMEs with a better record will opt for having higher debt levels.

JEL Codes: E52, E62, E63, F34, F41, H60.

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1 Introduction

The link between fiscal and monetary policies has been studied at least since Sargent & Wallace (1981), and Aiyagari & Gertler (1985). These papers, under different setups, consider the aggregate government budget constraint to assess key relationships between fiscal and monetary policies. Sargent & Wallace (1981) underscore that under a scheme in which fiscal policy dominates monetary policy, the authority might have little option other than accepting an inflation possibly higher than the one it initially intended. On the other hand, Aiyagari & Gertler (1985) describe how key monetary claims rely on fiscal accommodation. This is, they rely on monetary policy dominating.

On a closely related matter, the fiscal theory of the price level has been put forward. It allows the price level determination in some monetary models, which otherwise would not have a determined level, or as a price determination model in a cashless economy (e.g., see Christiano & Fitzgerald 2000).

In the empirical front, a number of issues of keen interest have been considered. For instance, the empirical determination of the degree of fiscal policy dominance (de Resende 2007). In addition, a problem of strong interest is to consider the government budget constraints to empirically test fiscal sustainability (Bohn 1998).

Against this background, we assess the relationship between fiscal sustainability and monetary policy attainment. Specifically, we measure such an attainment by an EMEs' historical inflation record and under the occurrence of one or several types of crises. In particular, we assess the response their primary balances have to changes in the debt level, controlling for a component of inflation, the current account, and what we call the primary balance's risk premium, among other relevant macroeconomic variables.

We do so by implementing a variation of the test carried out in Mendoza & Ostry (2008) for a set of economies, with two key differences. First, we use the inflation and growth components of seigniorage as a control.[1] We argue that albeit the aggregate government budget constraint includes seigniorage, the relevant component is the one associated with inflation and real growth. That is, we exclude the component associated with changes in money demand. We note that although the latter component is not inflationary, it still represents resources for the government.

Second, we also use the primary balance's risk premium as a control variable, which we approximate by the covariance between global consumption growth and the return of a hypothetical asset that would pay the primary balances of an economy each period.[2]

[1] This is, we know that seigniorage as a proportion of the nominal GDP can be decomposed into two elements, as follows $\frac{M_t - M_{t-}}{P_{t-1}Y_{t-1}} = \Delta \frac{M_t}{P_t Y_t} + \frac{\Delta Y_t P_t}{P_{t-1}Y_{t-1}} \frac{M_t}{P_t Y_t}$. In the regressions, we only control for the latter element.

[2] More specifically, $\frac{b_t + pb_t}{b_{t-1}}$ where b_t and pb_t represent debt and primary balance as share of GDP, respectively.

As a complementary exercise, we analyze the effect that several types of crisis episodes have on the test. In specific, we separate the EMEs in two groups: One with those that have had one or more episodes of a determined crisis type, against those that have not.

Summarizing our key results, we have the following comments. First, we find that EMEs, in general, exhibit sustainable fiscal policies. This is assessed given a sufficiency condition of the response the primary balances have to changes in the debt level. EMEs with a lower average inflation primary balances' response is smaller compared with those EMEs with a higher average inflation. Second, the inflation component is statistically significant as a control when we include EMEs with a shoddier inflation record. Third, based the tests, those EMEs with a better inflation attainment seem to be able to a higher level of sustainable debt in the long term. This does not mean that they opt for such a level.

2 Preliminaries

By assuming no arbitrage one can guarantee the existence of a stochastic discount factor, which prices all the financial assets in an economy (Duffie 2010). Then, one can consider the (theoretical) price of an asset that pays all of the primary balances plus the seigniorage of a given government. Under standard assumptions, its price should be equal to the government debt (Ljungqvist & Sargent 2012). We note that they derive such a relationship based on the aggregate budget constrain of the government, which is essentially equivalent to our approach.

In other words, the debt of a government has to be backed by two sources: taxes (present and future) and seigniorage. Thus, it must be the case that the value of present debt has to be equal to the price of the sum of all stream given by net taxes and seigniorage in the future. We thus have that:

$$B_t = \sum_{k=1}^{\infty} \mathbb{E}_t[S_{t+k}(PB_{t+k} + \Delta M_{t+k})]. \tag{1}$$

This relationship is used in a number of areas in the literature, e.g., in Sargent & Wallace (1981), in which, they explore the relationship between monetary and fiscal policy. In addition, it is used, in the study of fiscal sustainability (e.g., see Walsh 2003). In this context, there are two common assumptions made in this area. First, it is common to set $S_{t+k} = (1 + i_{t+k-1})^{-k}$. Note that this holds under particular assumptions. For instance, if the agent is risk-neutral or if one sees (1) as holding under certainty.

Depending on the context, it is also at times assumed that $\Delta M_{t+k} = 0$, which means that the government does not obtain any resources from seigniorage. While this assumption is reasonable for some economies, a number of governments still obtain some resources from this source, particularly so those if they are under fiscal stress. This would

evidently lead to the following equality.

$$B_t = \sum_{k=1}^{\infty} \mathbb{E}_t[(1 + i_{t+k-1})^{-k}(PB_{t+k})]. \tag{2}$$

As another example on the study of the relationship between fiscal and monetary policy, which can be seen as including the fiscal theory of the price level, it is common to see the same assumption being made; i.e., $S_{t+k} = (1 + i_{t+k-1})^{-k}$ (Walsh 2003):

$$B_t = \sum_{k=1}^{\infty} \mathbb{E}_t[[(1 + i_{t+k-1})^{-k}(PB_{t+k} + \Delta M_{t+k})]. \tag{3}$$

In both cases, an important role of uncertainty is implicitly eliminated. Thus, the associated tests focus (3).

We instead consider the more general expression (1), which we state below having used the following equality. For any given pair of random variables X and Y, $E(XY)$ equals the sum of $E(X)E(Y)$ and $\text{cov}(X, Y)$. See Ljungqvist & Sargent (2012) for its derivation based on the government budget constrain, and the assumption of existence of complete markets.

$$B_t = \sum_{k=1}^{\infty} \mathbb{E}_t[S_{t+k}]\mathbb{E}_t[(PB_{t+k} + \Delta M_{t+k})] + \text{cov}_t[S_{t+k}, PB_{t+k} + \Delta M_{t+k}]. \tag{4}$$

A central empirical problem is how to test whether (4) holds. Bohn proposes estimating the following linear relationship:

$$PB_t = \rho B_{t-1} + \mu_t + e_t,$$

where, as before, PB_t is the primary balance, B_t is the government, μ_t are some controls that could play a role to determine the primary balance, and e_t is an error term. More specifically, $\mu_t = \beta_0 + \beta x_t$, where x_t is a vector having a set of control variables. In our context, we use five macroeconomic variables, as explain below.

On the test, we have the following key comments. The null hypothesis of the test is for the coefficient ρ to be statistically significant, positive, and strictly less than one. For the validity of the test, he assumes the existence of complete markets. Importantly, given that the test is sufficient, a coefficient which is not statistically significant does not necessarily imply that the debt path is not sustainable. Moreover, if the associated coefficient is positive and greater than one, then one could interpret it as evidence for unsustainable debt. Nonetheless, not finding evidence favorable to the null hypothesis can imply that the model is invalid rather than the failure of the test. This is a joint-hypothesis problem, akin to the test of rational expectations in an asset pricing model. In addition, this test is robust in the sense that is holds under different standardization

of the relevant variables. In particular, its holds when on expresses the variables in terms of the nominal GDP. Importantly, in our empirical implementation, we standardized all variables by the nominal GDP.

On the control variables, we have the following remarks. First, about the component of inflation that is due to economic growth and inflation. We do not use the component that is associated with changes in money demand. Arguably, the former components are regular resources of the government, while the third component depends on the business cycle.

Second, the covariance term, which we approximate with the covariance of real consumption total growth and the return of the hypothetical financial asset previously mentioned. Here we use world consumption growth. Our assumption is that there is a world investor, which cares about the co-movements of primary balances with respect to world consumption. It is worth underlying that given the measuring error that consumption entail (compared to other variables), the associated magnitudes should be interpreted with caution.

Third, we control for the current account balance. As is well-known there is a well-documented relationship between the current account and the primary balance. This is commonly crystallized under the twin-deficit phenomena.

Fourth, we include the output and government expenditures gaps. Such variables intend to capture the business cycle components that could affect the primary balances. These two controls follow Mendoza & Ostry (2008) and Bohn (1998).

Finally, we focus on EMEs for three reasons. First and foremost, the fiscal resources they have obtained from seigniorage (relative to GDP) have been historically more important than those of AEs (Click 1998). Accordingly, their inflation record is more recent and, thus, their fiscal and monetary trade-offs could be more notable. Second, their inflation record is more scattered. Thus, empirically, one has a better ability to discern the implications of such a record in terms of some of its fiscal implications. Third, for similar reasons, EMEs are more granularly followed by the market regarding their fiscal performance. Conversely, AEs have tended to be more clustered in terms of their fiscal performances and inflationary records.

3 A Brief Literature Review

Bohn (1995 and 1998) studies debt sustainability for US debt. He posits the sufficiency test for the budget constrain to hold, run, and characterize the sustainable long-run debt values. A paper closely related to ours is that of Mendoza & Ostry (2008). They explore the fiscal sustainability for a set of EMEs and AEs, based on the approach proposed by Bohn (1995 and 1998).

International Monetary Fund. Research Dept (2003) analyzes the linear response of debt and primary balances in a set of emergent and advanced markets, this response resulted in general positive, as is in Mendoza & Ostry (2008). Also, they found that business cycle, inflation, commodity prices, and debt restructuring or default as control variables are statistically significant for emergent countries.

Celasun et al. (2006) take a probabilistic approach of fiscal behavior and sustainable debt levels for Argentina, Brazil, South Africa, and Turkey. They propose a stochastic debt sustainability analysis based on simulated path of debt levels, using a fiscal reaction function as the one in Bohn (1995 and 1998).

Abiad & Ostry (2005), following Bohn (1998), use as controls: output gap as a business cycle measure, inflation, commodity prices and revenue-to-GDP ratio. They also include a parliamentary and presidential election dummy variable, to take account political effects in the primary balance. They find that primary surpluses respond as expected to the business cycle, inflation, and commodity and oil prices. Furthermore, the find that surpluses were lower in election years and are higher in years when a country has an IMF-supported program.

On two related topics, we highlight the following two papers on the risk premium we use. First, Talvi & Vegh (2005) document that the fiscal policy in the G7 countries appears to be acyclical, while fiscal policy in developing countries is procyclical. This empirical result has implications on the interpretation of risk premium we use as a control variable in our estimation. Second, Piazzesi & Swanson (2008) document the relevance of accounting for the risk premium when making forecast based on futures. While the topic is unrelated to ours, they highlight the importance of the same object we do.

We briefly describe the definitions of the crisis that we use. For further explanation, we direct the interested reader to Reinhart & Rogoff (2009), where we have based or crisis sample. Next, we discuss some of the economic intuition behind that will help us to assess some of the effects that we find in our panel regressions.

A currency crisis takes place when an annual depreciation of at least 15 per cent takes place. As studied by Calvo et al. (2008), large real exchange rate fluctuations can come in tandem with systemic sudden stops in capital flows, which lead to a direct deterioration of the government primary balance; this lead, everything else constant, to lower available resources to the government. Also, one could expect that the current account balance will be affected by this kind of crisis; a severe exchange rate depreciation could derive in positive or negative effects in the trade balance. The latter will depend on the idiosyncratic characteristics of the economy in question.

Reinhart & Rogoff (2009) determined that a banking crisis occurs when one of two types of events takes place. First, if bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; or in the absence of runs, the closure, merging, takeover, or large-scale government assistance of an important

financial institution, that marks the start of a string of similar outcomes for other financial institutions takes place. As stated by Celasun et al. (2006), fiscal consequences of banking crises typically are expressed as below-the-line expenditures, therefore increasing the public debt burden without affecting recorded primary surpluses. That is, in theory, a banking crisis separation between economies will not have a substantial effect on the primary balance reactions.

An external debt crisis involves default on payment of obligations incurred under some foreign legal jurisdiction, it also contains the repudiation, or restructuring of debt into terms less favorable to the lender than in the original. As it has been studied in the sovereign default, such a decision usually entails the output state in which the government finds itself (see, e.g., Arellano 2008, Cuadra & Sapriza 2008, Hatchondo & Martinez 2009). Therefore, we expect to find that the coefficients associated with the output gap are more relevant for the primary balances; which, in turn, will be affected by a deterioration of the debt profile and, possibly, by a sudden-stop effect, discussed above.

An internal debt crisis is like the external case, but within the local jurisdiction. As stated by Reinhart & Rogoff (2009), information on domestic debt crises is scarce because they do not usually involve external creditors, helping many episodes to go unnoticed. An internal debt crisis typically occurs in much worse economic conditions than the average external default; moreover, some domestic defaults that forced the conversion of foreign currency deposits into local currency occurred during banking crises, hyperinflations, or a combination of both.

4 Data and Estimations

4.1 Data

Next, we describe our dataset. We consider an unbalanced panel of annual series for the following emergent countries: Argentina, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Ecuador, Egypt, Hungary, India, Indonesia, Israel, Ivory Coast, Jordan, Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Panama , Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine, Uruguay and Venezuela. Series include general government gross debt and total expenditures, primary balance and current account, all as shares of nominal GDP, and annual change in average consumer prices. The former series are from IMF's World Economic Outlook. Complementarily, real global consumption in USD and M1 series were obtained from World Bank and Haver Analytics, respectively. Our regressions were estimated from 1980 to 2016.

General government expenditures and logarithm of real GDP and, denoted as g_t and

y_t respectively, were decomposed using the Hamilton filter as follows:

$$\begin{aligned} y_t =& \tilde{y}_t + y_t^T, \\ g_t =& \tilde{g}_t + g_t^T, \end{aligned}$$

where $\tilde{y}_t(\tilde{g}_t)$ and $y_t^T(g_t^T)$ are the trend and cyclical component of the GDP (expenditures), respectively.

We also use the fluctuation of output and expenditures from Barro (1979) tax-smoothing model. Its specific definition is as follows:

$$\begin{aligned} YVAR_t =& \frac{y_t^T - y_t}{y_t^T} \frac{g_t^T}{y_t}, \\ GVAR_t =& \frac{g_t^T - g_t}{g_t^T} \frac{g_t^T}{y_t}. \end{aligned}$$

Note that the sign of YVAR is the opposite to that of the usual definition of the output cycle. In addition, covariance between the return over the hypothetical asset described in the introduction and global consumption growth was calculated using a window from t to $t-4$.

We obtained the crisis data from the Reinhart & Rogoff database. In specific we take the information of currency, banking, external and internal debt crisis. They cover 34 out of 56 of our country sample. From the 34 economies in the Reinhart & Rogoff database, only four have not had none of the mentioned crisis, while six have had the four considered crisis types. Importantly, if a country incurred in any of the considered crisis episodes in a determined time, we simply marked such an economy for the whole time period.

4.2 Panel Data Estimation

We estimate a set of panel data regression for different sets of EMEs in Table 1. In addition, we estimate our regressions with the same groups, but using white cross-section standard errors and covariances in Table 3. We note while we lose some statistical significance in the key parameter ρ, their pattern across our group is maintained.

As a complementary exercise, we explore the extent that different kinds of crisis could have on the test. As mentioned, we separate the EMEs based on if they have had one of the considered crises in the sample period. In specific, we consider currency, banking, and, external and internal debt crises. The panel results are presented in Table 4 and Table 5.

5 Discussion

On our initial estimates, we have the following remarks Table 1. First, the coefficient associated with debt indicates that the primary balances respond positively and significantly to an increase in the debt level. Based on sufficiency of the test in Bohn (1998), we have evidence favorable to the sustainability of their debts.

Second, centrally, as the EMEs with a higher inflation record are considered, we see that the primary balances respond more markedly to changes in their debt level. This suggests that the market imposes more discipline in their fiscal policy to those EMEs which have a poorer inflation record. As an important caveat, this does not mean that their fiscal policy is 'more sustainable' (Mendoza & Ostry 2008). As we discuss below, this has implications in terms of the sustainable debt level an economy can have in the long term.

When we consider the current account or the risk adjustment as controls in our panel regressions, they tend to be statistically significant only for the set of EMEs with a shoddier inflation record. The former reflects that the twin deficit phenomenon is more relevant in these economies, while the latter signals that, effectively, the debt of an EME with high levels of inflation is seen as riskier .

The inflationary component of the monetary base is statistically significant when we use it as control. Nonetheless, the magnitude of the coefficients associated with the group of EMEs with a better inflation record is more than half the magnitude of those with poorer inflation performances. Given the group composition that we take, this is an expected result; moreover, this evidence that is more probable that the countries with higher inflation levels finance its primary balances through seigniorage.

Similarly, the coefficients associated with output cycle ($\tilde{y}$) are statistically significant when included, but the magnitude of those associated with EMEs with higher inflation levels are higher than the ones of those with better inflation records. Note that when we use Barro's YVAR control instead, their statistical significance severely diminishes (columns 6 and 7, against columns 8 and 9).

When we consider the government expenditure gap measure ($\tilde{g}$), we have that the associated coefficients are negative and statistically significant; even when we use Barro's GVAR variable instead. This signals the relative importance of government expenditures to primary balance responses, and, importantly, its presence does not affect the validation of Bohn's test.

Sixth, our constants' estimates seem to be (in absolute value) above of those estimated by Mendoza & Ostry (2008). We note that our estimation sample differs; while we use data up until 2015, they reach the data available at their time. In addition, they report an average constant, not reporting individual constants. These have no direct interpretation for the panel regression estimates, but have important implications for the estimates of

the sustainable debt in the long-run, as we discuss in the next section.

5.1 Panel Regressions with Crises Data

In general, the presence of a crisis could raise some eyebrows about the validity of the implemented test. This is particularly the case for currency and domestic default crises. It is evident that, during some of such crises, general economic conditions and, therefore, the relationship between macroeconomic variables are not the usual ones.

When we include an indicator equal to 1 when some type of crisis have had took place, we find that those EMEs that have had crises have, in general, a lower primary balance reaction to changes in debt levels compared to those that did not had the chosen crisis.

Therefore, a better historic economic performance seems to help EMEs. As mentioned, as a corollary, they could access to higher sustainable levels of debt.

Noticeable, for these panel regressions, the risk adjustment term is statistically more important in bad states, i.e., when EMEs have high average inflation and in EMEs with crises episodes. This suggest that investors keep a close eye in those EMEs with lower performances, as one would expect.

- **Currency Crisis**
  - A negative current account coefficient presents evidence of a trade balance effect under a currency crisis (cheaper exports, but much more expensive imports).
  - Note that, we have the usual twin deficit phenomenon for the group that has not had a currency crisis.
- **Banking Crisis**
  - Higher expenditures coefficient. For example: Banking rescue using public resources can imply a higher primary deficit.
- **External Default Crisis**
  - The coefficient of the cyclic component of output is significant. Primary balances of a country with external default will be sensitive to the output gap as default decisions usually affects the output directly.

5.2 Sustainable Debt Levels in the Long Term

Bohn (1998) derives the debt level which would be sustainable in the long term. Our estimates have important implications in this regard. We have that such a limit is given

by the following expression:

$$E(b) = -\hat{\mu}[\rho(1+\hat{r}) - \hat{r}], \tag{5}$$

where $\hat{\mu}$ is the average value of $\mu_t = \beta_0 + \beta x_t$, $\hat{r}$ is the real average rate (r) minus the average growth of per-capita real GDP ($\bar{g}$). Centrally, we note that it is inversely related to the estimate of ρ. This last property provides us with one of our central results. Based on the pattern presented by the ρ's in our regression, as more EMEs with a higher average inflation are included, its magnitude increases (Table 1). Thus, our estimates suggest that as the inflation record of EMEs declines, the level of debt which is sustainable in the long-run decreases (Table 2).

One can interpret these results as follows, having a better inflation record helps EMEs in two related ways. First, EMEs with a better inflation record have a less need for their primary balances to respond to changes in their debts level. Second, the levels of debt that are sustainable in the long run, are greater compared to those EMEs which have failed to obtain a stronger inflation record. We note that this results with the simple comparison between the average level of debt of each group and their average inflation. In effect, we have that the average level of debt decreases as we advance from groups I to X in Table 1. In sum, the market seems to be more lenient to EMEs with a better inflation record.

As an important comment, we have presented our estimates based on relative debts. We do because our estimate of $\bar{\mu}$ implies level of debt which are higher than those observed. As mentioned, our estimates of the constants are greater (in absolute values) compared to those in Mendoza & Ostry (2008).

Moreover, in the last subsection we document that the coefficients associated with the inflation component were negative. This suggest that as more EMEs with a shoddier inflation record are included, the referred component plays a more important role. This is, a higher inflation at the margin helps alleviate the primary balance of an economy. This possible benefit is surpassed by need to adjust the primary balance to change in the debt level and the lower level of debt that sustainable in the long-run.

We have also explored the relative contribution for the level of sustainable debt from each of the main control variables we have used. Next, we focus on the inflation component and the current account. In line with the interpretation of the coefficient associated with inflation, since it is negative and the average inflation component is positive, it contributes positively to level of debt which is sustainable. Nonetheless, we note that its contribution is notably smaller relative to that of the size of primary balance's response to changes in debt (i.e., the ρ coefficient). In other words, such a response plays a much more central role in the determination of the level of debt which is sustainable in the long run.

Second, on the current account, as mentioned, we note the associated coefficients are all positive and increase as we move from left to right in the table. In the long term, the current account should be zero. Thus, its contribution should be nil. At the margin, its contribution is negative (positive) for an economy that has a current account surplus (deficit).

A question of keen interest is whether those EMEs which can sustain a higher level of debt in the long term do issue to such levels. In other words, one could argue that economies have in principle the option of issuing debt to a level as high as they want as long as it does not surpass a sustainable one. Thus, we assess how close are our empirical average debt to those implied by the test. We document that those economies which maintain a better inflation record seem to maintain a level of debt which is lower relatively to their sustainable levels compared to groups of EMEs which have a poorer inflation record.

6 Final Remarks

We have explored the link between debt sustainability and monetary policy attainment in a set of EMEs. As our main exercise, we have considered how the primary balance responds to changes in debt. To operationalize this test, we have estimated a set of panel data regressions using different controls. While this test is intuitive from an econometrical point of view, it has theoretical foundations.

We then grouped the economies depending if their average inflations are above or below a threshold, if they have had a currency, banking, external or internal debt crisis. In general, we find that EMEs with poorer inflation records or those that have had one or more of the mentioned crises, have primary balances that react more distinctly to changes in the debt level. In addition, we find that their primary balances depend negatively on the inflationary component and positively on their current accounts, echoing the twin-deficit phenomena.

Those groups that have had a better macroeconomic record can have higher sustainable levels of debt in the long term. That said, this does not mean that those EMEs that have a better record have necessarily opted for contracting higher levels of debt levels.

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Appendices

A Crisis Episodes Country List

Table A.1: Crises Occurrence Flag

Country	Currency	Banking	External Default	Domestic Default
Argentina	1	1	1	1
Brazil	1	1	1	1
Bulgaria	1	1	1	0
Chile	1	1	1	0
China	0	1	0	0
Colombia	0	1	0	0
Costa Rica	0	1	1	0
Ivory Coast	0	1	1	0
Croatia	0	0	0	0
Ecuador	1	1	1	1
Egypt	0	1	1	0
Hungary	1	1	0	0
India	0	1	1	0
Indonesia	1	1	1	0
Israel	0	0	0	0
Jordan	0	0	0	0
Korea	0	1	1	0
Malaysia	1	1	0	0
Mexico	1	1	1	1
Morocco	0	1	1	0
Nigeria	0	1	1	0
Pakistan	0	0	0	0
Panama	0	1	1	1
Peru	0	1	1	1
Philippines	1	1	1	0
Poland	0	1	1	0
Romania	0	1	1	0
Russia	1	1	1	1
South Africa	0	1	1	1
Thailand	1	1	1	0
Turkey	1	1	1	0
Ukraine	1	0	0	0
Uruguay	0	1	1	0
Venezuela	1	1	1	1

Notes: : 1 = Yes, 0 = No. *Source*: With data form Reinhart and Rogoff crises dataset.

B Figures and Tables

Table 1: Panel Data Estimates

	(1) Lower	(2) Higher	(3) Lower	(4) Higher	(5) All	(6) Lower	(7) Higher	(8) Lower	(9) Higher
ρ	**0.064*** **	**0.045*** **	**0.053*** **	**0.045*** **	**0.042*** **	**0.036***	**0.046*** **	**0.044** **	**0.046*** **
	(0.017)	(0.012)	(0.017)	(0.011)	(0.011)	(0.021)	(0.015)	(0.020)	(0.015)
Current Account			**0.011**	**0.122*** **	**0.73*** **	**0.035**	**0.099*** **	**0.038**	**0.088** **
			(0.035)	(0.038)	(0.027)	(0.043)	(0.037)	(0.041)	(0.037)
$\tilde{y}$			**0.16*** **	**0.14*** **	**0.07*** **	**0.09** **	**0.06**		
			(0.04)	(0.02)	(0.02)	(0.05)	(0.02)		
$\tilde{g}$			**-0.09*** **	**-0.04*** **	**-0.06*** **	**-0.09*** **	**-0.04*** **		
			(0.016)	(0.010)	(0.010)	(0.020)	(0.012)		
Inflation Component					**0.36*** **	**0.27*** **	**0.64*** **	**0.30*** **	**0.067*** **
					(0.08)	(0.094)	(0.131)	(0.089)	(0.132)
Risk Adjustment					**-0.46**	**-0.20**	**-0.48*** **	**-0.12**	**-0.48*** **
					(0.09)	(0.23)	(0.09)	(0.22)	(0.09)
YVAR								**-0.65** **	**-0.41** **
								(0.28)	(0.20)
GVAR								**-0.37*** **	**-0.33*** **
								(0.07)	(0.10)
Constant	**-3.49** **	**-2.59** **	**-3.18** **	**-2.19** **	**-2.91*** **	**-3.47** **	**-3.05*** **	**-4.13*** **	**-3.11*** **
	(1.57)	(1.01)	(1.51)	(0.93)	(0.90)	(1.47)	(0.98)	(1.38)	(0.97)
N	173	470	161	418	445	114	331	114	331
N_i	8	26	8	25	28	6	22	6	22
adj. R^2	0.57	0.62	0.63	0.62	0.66	0.68	0.67	0.62	0.66

Notes: Regresions include country fixed effects and have the form $PB_t = \rho B_{t-1} + \mu_t + \epsilon_t$, where PB_t is the primary balance B_{t-1} is debt level in the previous period. An inflation component, a risk premium, the current account and the detrended component of output and general government expenditures were included as controls in μ_t. Standard errors in parentheses. *, ** and *** denote that the corresponding coefficient is statistically significant at the **90**, **95** and **99** percent confidence levels, respectively. The panel is unbalanced with samples that cover mainly the 1980–2016 period.

Table 2: Sustainable Debt Levels Estimated with Eq. 5 and Values of Coefficients in Table 1

	(1) Lower	(2) Higher	(3) Lower	(4) Higher	(5) All	(6) Lower	(7) Higher	(8) Lower	(9) Higher
Sustainable debt level in the long run	64.1	72.0	72.8	61.3	76.0	102.2	67.3	91.2	67.7
Stability Condition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: $\hat{r}$ is the difference in the long-run averages of the real interest rate r and the per-capita growth rate of real GDP. Without loss of generality, we assume $\bar{g} = 2$ and $r = 3$ because our interest is to observe changes in sustainable debt levels as inflation growths. $\bar{\mu}$ was approached by different sets of assumptions. First, we consider all the control variables $\tilde{y}$, $\tilde{g}$, current account, the inflation component and the risk adjustment. In subsequent assumptions we estimate $\bar{\mu}$ without considering the inflation component. Debt ratio stands for the proportion between average debt and long-run debt for each group, i.e., how much of long-run debt actually take, in average, a country in a particular inflation group.

Table 3: Panel Data Estimates with Country Fixed Effects and White Cross-section Standard Errors and Covariances

	(1) Lower	(2) Higher	(3) Lower	(4) Higher	(5) All	(6) Lower	(7) Higher	(8) Lower	(9) Higher
ρ	**0.064****	**0.045*****	**0.053****	**0.045*****	**0.042****	**0.036**	**0.046****	**0.044***	**0.046****
	(0.028)	(0.012)	(0.027)	(0.015)	(0.016)	(0.025)	(0.018)	(0.023)	(0.018)
Current Account			**0.011**	**0.122*****	**0.73*****	**0.035**	**0.099****	**0.038**	**0.088****
			(0.034)	(0.043)	(0.026)	(0.048)	(0.040)	(0.050)	(0.041)
$\tilde{y}$			**0.16*****	**0.14*****	**0.07*****	**0.09***	**0.06****		
			(0.05)	(0.05)	(0.02)	(0.06)	(0.03)		
$\tilde{g}$			**-0.09*****	**-0.04****	**-0.06*****	**-0.09*****	**-0.04*****		
			(0.02)	(0.01)	(0.01)	(0.03)	(0.01)		
Inflation Component					**0.36*****	**0.27***	**0.64*****	**0.30*****	**0.067*****
					(0.11)	(0.139)	(0.184)	(0.113)	(0.185)
Risk Adjustment					**-0.46***	**-0.20**	**-0.48****	**-0.12**	**-0.48****
					(0.25)	(0.23)	(0.22)	(0.29)	(0.23)
YVAR								**-0.65**	**-0.41***
								(0.40)	(0.23)
GVAR								**-0.37*****	**-0.33*****
								(0.09)	(0.11)
Constant	**-3.49*****	**-2.59*****	**-3.18*****	**-2.19*****	**-2.91*****	**-3.47*****	**-3.05*****	**-4.13*****	**-3.11*****
	(1.03)	(0.64)	(1.01)	(0.56)	(0.57)	(1.29)	(0.71)	(1.27)	(0.72)
N	173	470	161	418	445	114	331	114	331
N_i	8	26	8	25	28	6	22	6	22
adj. R^2	0.57	0.62	0.63	0.62	0.66	0.68	0.67	0.62	0.66

Notes: Regresions include country fixed effects and have the form $PB_t = \rho B_{t-1} + \mu_t + \epsilon_t$, where PB_t is the primary balance B_{t-1} is debt level in the previous period. We use White cross-section standard errors and covariances. An inflation component, a risk premium, the current account and the detrended component of output and general government expenditures were included as controls in μ_t. Standard errors in parentheses. *, ** and *** denote that the corresponding coefficient is statistically significant at the **90**, **95** and **99** percent confidence levels, respectively. The panel is unbalanced with samples that cover mainly the 1980–2016 period.

Table 4: Panel Data Estimates with Crises Data

	All EMEs	Avg. Inflation vs. Median		Currency Crisis		Banking Crisis		External Default Crisis		Domestic Default Crisis		Any of the mentioned	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
ρ	0.042**	0.036	0.046**	0.45**	0.029	0.049***	0.043	0.048***	0.033	0.046***	-0.043	0.051***	0.045*
	(0.016)	(0.025)	(0.018)	(0.018)	(0.037)	(0.013)	(0.034)	(0.016)	(0.038)	(0.017)	(0.053)	(0.012)	(0.023)
Inflationary Component	0.36***	0.27*	0.64***	0.42***	0.17	0.45***	0.28**	0.31**	0.048**	0.36**	0.52	0.57***	0.28**
	(0.11)	(0.14)	(0.18)	(0.13)	(0.12)	(0.16)	(0.14)	(0.12)	(0.23)	(0.11)	(0.34)	(0.16)	(0.13)
Risk Adjustment	-0.46*	-0.20	-0.48***	-0.56**	-0.40*	-0.27	-0.51**	-0.32	-0.52**	-0.47*	-0.47***	-0.05	-0.48*
	(0.25)	(0.28)	(0.22)	(0.25)	(0.22)	(0.25)	(0.25)	(0.21)	(0.26)	(0.26)	(0.08)	(0.20)	(0.26)
Current Account	0.07***	0.04	0.10**	0.18***	-0.07*	0.11**	0.07*	0.07	0.11**	0.07***	-0.10	0.14***	0.05
	(0.03)	(0.05)	(0.04)	(0.03)	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.03)	(0.10)	(0.05)	(0.03)
$\tilde{y}$	0.07***	0.09*	0.06**	0.10**	0.06**	0.09**	0.09***	0.05*	0.11***	0.06**	0.14***	0.26***	0.07***
	(0.02)	(0.06)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.05)	(0.02)
$\tilde{g}$	-0.06***	-0.09***	-0.04***	-0.06***	-0.05**	-0.09***	-0.5***	-0.07***	-0.05**	-0.06***	0.01	-0.14	-0.05***
	(0.01)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)	(0.03)	(0.01)
Constant	-2.91***	-3.47**	-3.05***	-3.69***	-1.21	-5.32***	-2.43	-4.48***	-1.96	-3.18***	0.64	-6.16***	-2.56**
	(0.90)	(1.47)	(0.98)	(1.03)	(1.62)	(1.06)	(1.52)	(0.99)	(1.64)	(0.91)	(3.10)	(0.99)	(1.14)
N	445	114	331	263	182	81	364	155	290	401	44	64	381
N_g	28	6	22	16	12	5	23	9	19	24	4	4	24
adj. R^2	0.67	0.68	0.68	0.69	0.64	0.68	0.67	0.62	0.69	0.67	0.83	0.78	0.66

Notes: Regresions include country fixed effects and have the form $PB_t = \rho B_{t-1} + \mu_t + \epsilon_t$, where PB_t is the primary balance B_{t-1} is debt level in the previous period. We use White cross-section standard errors and covariances. An inflation component, a risk premium, the current account and the detrended component of output and general government expenditures were included as controls in μ_t. Standard errors in parentheses. *, ** and *** denote that the corresponding coefficient is statistically significant at the **90**, **95** and **99** percent confidence levels, respectively. The panel is unbalanced with samples that cover mainly the 1980–2016 period.

Table 5: Panel Data Estimates with Crises Data and White Cross-section Standard Errors and Covariances

	All EMEs	Avg. Inflation vs. Median		Currency Crisis		Banking Crisis		External Default Crisis		Domestic Default Crisis		Any of the mentioned	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
ρ	0.042**	0.044*	0.046**	0.04**	0.03	0.49***	0.043	0.048***	0.33	0.046***	-0.043	0.051***	0.045*
	(0.023)	(0.023)	(0.435)	(0.016)	(0.037)	(0.011)	(0.034)	(0.014)	(0.038)	(0.015)	(0.050)	(0.012)	(0.024)
Inflationary Component	0.39***	0.30***	0.67***	0.46***	0.19	0.44***	0.30**	0.33***	0.52**	0.38***	0.70**	0.56***	0.31**
	(0.11)	(0.11)	(0.150)	(0.10)	(0.13)	(0.13)	(0.14)	(10.10)	(0.23)	(0.10)	(0.34)	(0.14)	(0.13)
Risk Adjustment	-0.45*	-0.12	-0.48**	-0.54**	-0.42*	-0.17	-0.51**	-0.28	-0.53**	-0.46*	-0.45***	-0.15	-0.49*
	(0.29)	(0.29)	(0.06)	(0.26)	(0.22)	(0.24)	(0.26)	(0.21)	(0.27)	(0.27)	(0.09)	(0.24)	(0.26)
Current Account	0.07***	0.04	0.09**	0.18***	-0.08**	0.11**	0.06	0.07	0.09*	0.07**	-0.05	0.14**	0.04
	(0.05)	(0.05)	(0.04)	(0.03)	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.03)	(0.11)	(0.06)	(0.03)
$\tilde{y}$	-0.57***	-0.65	-0.41*	-0.78***	-0.44**	-0.72***	-0.73***	-0.48**	-0.81***	-0.46**	-1.35***	-1.07***	-0.49***
	(0.40)	(0.40)	(0.03)	(0.26)	(0.20)	(0.23)	(0.23)	(0.20)	(0.25)	(0.18)	(0.35)	(0.24)	(0.17)
$\tilde{g}$	-0.36***	-0.37***	-0.33***	-0.37***	-0.43**	-0.32***	-0.41***	-0.33***	-0.41***	-0.36***	0.10	-0.36***	-0.42***
	(0.09)	(0.09)	(0.20)	(0.07)	(0.20)	(0.07)	(0.13)	(0.07)	(0.16)	(0.06)	(0.27)	(0.07)	(0.12)
Constant	-2.94***	-4.13***	-3.11***	-3.70***	-1.23	-5.40***	-2.45	-4.53***	-2.02	-3.20***	1.29	-5.70***	-2.57**
	(1.38)	(1.38)	(0.45)	(0.91)	(1.63)	(0.87)	(1.53)	(0.85)	(1.65)	(0.83)	(2.43)	(0.91)	(1.19)
N	445	114	331	263	182	81	364	155	290	401	44	64	381
N_g	28	6	22	16	12	5	23	9	19	24	4	4	24
adj. R^2	0.68	0.71	0.68	0.71	0.64	0.71	0.67	0.65	0.69	0.68	0.82	0.77	0.66

Notes: Regresions include country fixed effects and have the form $PB_t = \rho B_{t-1} + \mu_t + \epsilon_t$, where PB_t is the primary balance B_{t-1} is debt level in the previous period. We use White cross-section standard errors and covariances. An inflation component, a risk premium, the current account and the detrended component of output and general government expenditures were included as controls in μ_t. Standard errors in parentheses. *, ** and *** denote that the corresponding coefficient is statistically significant at the **90**, **95** and **99** percent confidence levels, respectively. The panel is unbalanced with samples that cover mainly the 1980–2016 period.

Table 6: Sustainable Debt Levels Estimated in the Long Run

	All EMEs	Avg. Inflation vs. Median		Currency Crisis		Banking Crisis		External Default Crisis		Domestic Default Crisis		Any of the mentioned	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Using $\tilde{y}$ and $\tilde{g}$	76.0	102.2	67.3	90.6	61.0	113.7	65.7	96.6	67.8	74.3	24.1	126.7	65.3
Stability Condition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Using YVAR and GVAR	76.1	90.1	66.7	92.3	60.6	116.7	65.9	100.3	67.2	74.6	33.9	129.6	65.4
Stability Condition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

Notes: $\hat{r}$ is the difference in the long-run averages of the real interest rate r and the per-capita growth rate of real GDP. Without loss of generality, we assume $\bar{g} = 2$ and $r = 3$ because our interest is to observe changes in sustainable debt levels as inflation growths. $\bar{\mu}$ was approached by different sets of assumptions. First, we consider all the control variables $\tilde{y}$, $\tilde{g}$, current account, the inflation component and the risk adjustment. In subsequent assumptions we estimate $\bar{\mu}$ without considering the inflation component. Debt ratio stands for the proportion between average debt and long-run debt for each group, i.e., how much of long-run debt actually take, in average, a country in a particular inflation group.