Inflation, Default Risk, and Nominal Debt*

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Abstract

This paper studies the trade-off between strategic inflation and default in emerging market economies that borrow primarily in their local currency. Using over-the-counter derivatives data, I document a robust, positive correlation between default risk, currency risk, and realised inflation. I use these facts to discipline a quantitative sovereign default model in which the government issues nominal debt and lacks commitment to both fiscal and monetary policy. I show that simple models of debt dilution via default and inflation predict a negative, counterfactual comovement between the two instruments because they act as substitutes. Introducing monetary financing resolves this tension: in bad times, seigniorage provides a flexible source of funding when other policy margins are difficult to adjust, allowing the model to match the correlations observed in the data.

Keywords: Sovereign default, default risk, inflation, seigniorage

JEL Codes: E3, E4, E6, F3, H6

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1 Introduction

In the last two decades, many emerging market (EM) governments significantly tilted the currency composition of their public debt from foreign to local currency. Borrowing in local currency makes inflation an additional instrument for public debt management, on top of repayment through fiscal surpluses and outright default. This raises the question of how default and inflation temptations interact and shape macroeconomic policies in EMs. The inflation and default spreads embedded in government bond interest rates have a critical role in determining the trade-off between the ex-post benefits and the ex-ante costs of these policies in the presence of time inconsistencies. A key empirical regularity in the sovereign default literature is the countercyclicality of default spreads, which constrains borrowing in situations where the government needs it the most. Whether inflation spreads display the same or the opposite feature has crucial implications for the ability of the issuer to use debt policy as a way to smooth shocks over time.

This paper studies in detail the relationship between default risk, inflation risk, and realised inflation for a set of large EM sovereigns. A common argument regarding countries that borrow in their own currency is that they need not default on their debt because they can always resort to the printing press in case of need. I show that, in the data, default risk remains non-negligible and displays a robust, positive relationship with realised and expected inflation, despite the significant shift in government debt composition towards local-currency debt. I use these facts to discipline the behaviour of default and inflation spreads in a quantitative sovereign default model where a government issues debt in domestic currency and lacks commitment to both fiscal and monetary policy. I find that, to reconcile the model with the data, it is important to account for the role of inflation as a tool to raise fiscal revenues, especially in periods when other margins are difficult or expensive to adjust.

The empirical section of the paper documents a number of stylised facts on the relationship between default risk, currency risk, realised inflation, and exchange rate depreciation for a set of eleven large EM economies. I exploit the availability of over-the-counter derivatives that price default and currency risks separately: I use credit default swaps (CDSs) as an indicator of default risk, and fixed-for-fixed cross-currency swaps as an indicator of the expected depreciation of a currency against the US dollar, which I use as a proxy for expected inflation. Using different assets has the advantage of avoiding an econometric decomposition of local-currency sovereign spreads into default and currency premia, and addresses liquidity problems in government debt markets since the derivatives considered are standardised and liquid.

I highlight three facts that emerge from the data. First, looking at long-run averages across countries, countries with high default risk display high levels of realised inflation and exchange rate depreciation, both realised and in expectation. Second, inflation and default risk are positively correlated within each country at short-run frequencies. This relationship is robust to controlling for global risk factors that may drive investors' risk premia. Third, default risk also comoves with realised inflation and exchange rate depreciation within each country and at short-run frequencies.

Based on this evidence, I develop a quantitative sovereign default model with nominal debt to study the joint behaviour of default risk and expected and realised inflation. The model is a version of the workhorse sovereign default model where external debt is denominated in domestic currency and the government lacks commitment to both fiscal and monetary policy. I follow the literature in assuming that inflation is a continuous instrument with convex costs, while default is a binary choice that entails a fixed output cost and temporary exclusion from debt markets.

First, I test the simplest version of the model, where inflation only serves the purpose of diluting the real value of debt. A priori, it is not obvious whether inflation and default risks should comove. Consider the effect of a bad shock to output that is however short of causing a default. First, this creates stronger incentives for the government to inflate debt away because the marginal benefit of freeing up resources goes up. Second, the probability of a default increases because output shocks are persistent. In a default, however, debt is reduced via a haircut, which lowers the incentive to further reduce it via inflation. Third, higher default spreads make new borrowing costlier, offsetting the stronger incentive to borrow for consumption smoothing purposes. This makes debt issuance procyclical, a common finding of both the empirical and quantitative literature. The interplay between these mechanisms determines the net effect of the output shock on realised and expected inflation, and in turn on their correlation with default spreads. I calibrate the model to Brazil and find that the last two forces dominate, implying a negative, counterfactual correlation between default spreads, inflation spreads, and realised inflation. This is due to the procyclicality of debt, which makes inflation incentives weak when the government is close to the default frontier, and to the fact that inflation upon default is lower than in repayment.

Second, I show how the model can be reconciled with the data by giving inflation the second purpose of raising fiscal revenues via seigniorage. Specifically, I modify the model along two dimensions: first, I assume that the government is constrained in the amount of lump-sum taxes it can collect from households; second, I allow for endogenous government spending and assume its utility has a higher curvature than that of private consumption. When the constraint on lump-sum taxation binds, it drives a wedge between the marginal utility of public and private consumption, creating a role for inflation as an alternative means of raising fiscal revenues for the government. In the model, inflation therefore serves a dual purpose: it taxes foreign lenders by diluting the real value of external debt, and domestic households through seigniorage. The relative importance of these two functions, and the way in which they are embedded into sovereign bond spreads through expectations, are crucial for the ability of this framework to generate the comovement between inflation and default risk that I observe in the data.

I evaluate the strength of these forces by recalibrating the model. Inflation is especially useful as a source of fiscal revenues when the sovereign has a strong incentive to smooth public consumption and other margins are difficult to adjust, that is, when lump-sum taxes are constrained and high spreads make external borrowing expensive. This implies that, when output is low and default spreads are high, the sovereign reduces borrowing and uses the inflation tax instead. As a result, inflation becomes countercyclical, and inflation and default spreads display the positive correlation that is found in the data.

Relation to the literature. This paper relates to several strands of the literature on sovereign default and monetary policy. A literature that dates back to the seminal work of Calvo (1988) analyses time-consistent monetary and fiscal policy with sovereign default, considering the role of inflation and exchange rate devaluation as an implicit way to default on local-currency debt, and studying their interplay with explicit default. A number of recent theoretical and quantitative papers have addressed this issue by embedding a monetary side into real sovereign default models in the tradition of Eaton and Gersovitz (1981), Arellano (2008), Aguiar and Gopinath (2006) and a large body of subsequent work.

Aguiar et al. (2014) and Hurtado et al. (2022) consider a domestic planning problem and examine, respectively via theoretical and quantitative approaches, the trade-off between the ex-post benefits and the ex-ante costs of using discretionary inflation to dilute the real value of debt. Using a similar setup, I highlight what aspects are key in matching asset price correlations in the data.

Roettger (2019), Sunder-Plassmann (2020) and Espino et al. (2025) are closest to this paper and study distortionary and discretionary domestic fiscal and monetary policy within a model of a small open economy that borrows through nominal, defaultable debt. Sunder-Plassmann (2020) analyses the case where the sovereign issues debt with different ownership structures or currency denomination. Espino et al. (2025) consider a tradable-nontradable economy and study the effect of shocks to the terms of trade or productivity. This work complements their analyses by providing empirical evidence on asset prices, and clarifying the implications of different assumptions on the quantitative performance of the model, isolating the mechanisms that are key to reconcile it with the data.

A related strand of the literature studies the relationship between inflation and default when debt is nominal, but takes different approaches. Araujo et al. (2013), Aguiar et al. (2013, 2015), Corsetti and Dedola (2016), and Bassetto and Galli (2019) examine the role of inflation as partial default within the context of self-fulfilling runs on government debt. By contrast, I abstract from belief-driven crises and follow much of the quantitative literature in focusing on defaults driven by fundamentals. Engel and Park (2018), Ottonello and Perez (2019), and Du et al. (2016) study the currency composition of debt when the government lacks commitment to repay and to inflate, to rationalise the recent surge in local-currency borrowing. I abstract from this margin for reasons of tractability, and focus on countries that have self-selected into issuing most of their debt in local currency.

A recent body of work studies optimal default and monetary policy in economies with nominal rigidities. Na et al. (2018) show that downward wage rigidities can rationalise the joint occurrence of defaults and large exchange rate devaluations: during a default, optimal exchange rate policy calls for a reduction in the real value of wages that stimulates employment. Bianchi et al. (2019), Bianchi and Mondragon (2021), and Romei and de Ferra (2018) consider similar frameworks to respectively study optimal fiscal policy, self-fulfilling debt runs, and monetary unions. In these papers, inflation either creates deadweight losses (in the case of price rigidities) or stimulates output by reducing involuntary unemployment (in the case of downward wage rigidities), but does not provide debt relief and is not priced in debt contracts, since debt is assumed to be denominated in foreign currency. Arellano et al. (2020) embed an external default model within a New Keynesian open economy framework with commitment on the monetary side, and study the comovement of default spreads with realised inflation and short-term nominal rates.[1] These works propose different mechanisms through which realised and expected inflation comoves with default spreads, specifically through the fact that defaults result in high inflation. This paper shows a complementary channel that only relies on the cyclical properties of inflation in repayment periods.

Finally, the treatment of inflation as a source of fiscal revenues in this paper is also related to the literature on currency and balance-of-payment crisis, dating back to the seminal contribution of Krugman (1979) and the large body of subsequent work. With respect to this class of models, I consider default, and I model endogenously the reason behind the use of seigniorage revenues to fund fiscal deficits.

The paper proceeds as follows: Section 2 presents a number of stylised facts about the relationship between default risk, currency risk, and realised inflation; Section 3 presents the model environment; Section 4 illustrates the main mechanisms; Section 5 analyses the quantitative performance of the model; Section 6 concludes.

[1] Maeng (2024) considers a similar framework where the sovereign also chooses the currency denomination of debt.

2 Empirical Observations

This section describes the data and documents a number of facts about the relationship between default risk, currency risk, realised inflation, and exchange rate depreciation.

2.1 Data

The sample is composed of the following 11 countries: Brazil, Colombia, Hungary, Indonesia, Mexico, Malaysia, Poland, Russia, Thailand, Turkey, and South Africa. These countries are chosen on the basis of size, data availability, and the following two important features. First, they all have relatively flexible exchange rate arrangements, i.e. belong to Categories 3 or 4 in the coarse classification of Ilzetzki et al. (2019) for the majority of the sample.[2] Second, the majority of their debt is denominated in local currency, as illustrated by Figure 1. The figure plots the average share of general government debt denominated in local currency over the sample period, distinguishing between total debt (blue bars) and debt only owned by external creditors (red bars).

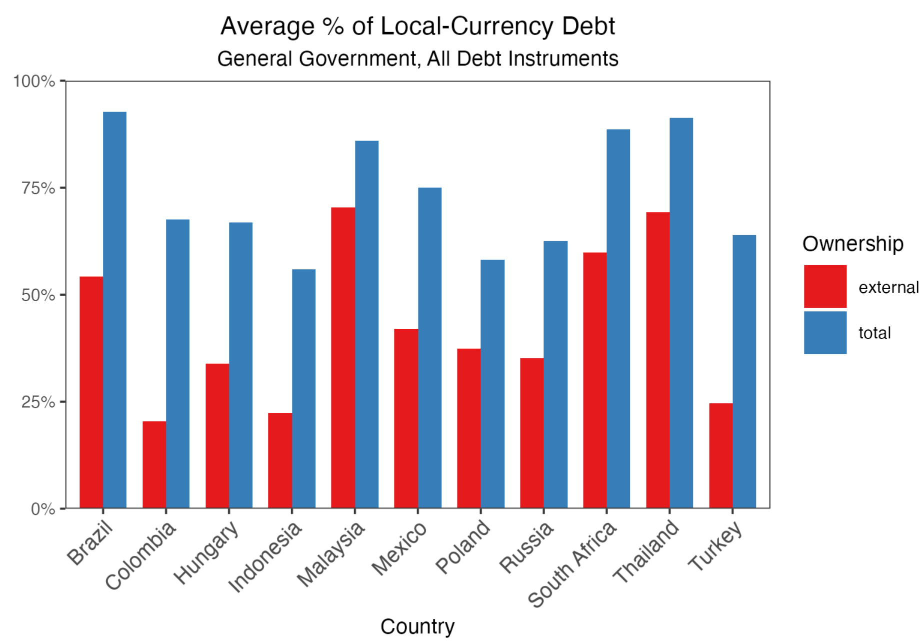

Figure 1: Average share of government debt denominated in local currency. Government debt is defined as loans and securities of the general government.

Data are quarterly series. The sample period is dictated by data availability: most of the data is for the period 2004q1-2019q4, although some data series for some countries start later. The

[2] Categories 3 and 4 correspond to "managed floating" and "freely floating" respectively. Hungary and Indonesia are an exception and belonged to Category 2 ("crawling pegs") for about two thirds of the sample.

data sources are the following. Data on derivatives prices is taken from Bloomberg, Refinitiv, and Du and Schreger (2016a). Data on inflation, exchange rates, and GDP is taken from Refinitiv, the IMF International Financial Statistics, and national data sources. Government debt data is taken from Arslanalp and Tsuda (2014). I now provide more details on each of the data series used.

Default risk. To measure default risk, I use credit default swaps (CDSs henceforth). These are over-the-counter derivatives that quote the premium (commonly called spread) that investors must pay to insure against a credit event on a country's sovereign debt. Credit events include a set of circumstances normally associated with default and debt restructuring, such as postponements or cancellation of interest or principal payments.

A number of features make these derivatives a particularly compelling measure of default risk. First, they are standardised instruments, which gives them a constant maturity and makes them generally more liquid than foreign currency government debt. Second, counterparty risk is not a concern for any of the derivatives data used in this paper, because mark-to-market positions in over-the-counter derivatives are collateralised on a daily basis. Third, CDSs are denominated in US dollars, which means that the payoff of the instrument is insulated from the value of the issuer's currency and its (expected) correlation with a default episode. Fourth, they are based on bonds issued under international law, which shields them from country-specific idiosyncrasies and capital control legislation.

The last aspect concerning debt jurisdiction is important and deserves further discussion. It implies that these CDSs are effectively pricing the risk of default on a fraction of total public debt, and if a country were to selectively default only on debt issued under national law, these CDSs would not be triggered. As most of the literature, this paper focuses on defaults on external debt, that is, debt held by foreign investors. Debt ownership and jurisdiction are two distinct concepts, but they tend to coincide since international law debt is typically held by foreign investors. While the fact that the majority of many EM issuers' debt stock is denominated in local currency is especially true when considering total public debt, it still holds when only focusing on external debt. Moreover, the frequency of defaults on domestic- and foreign-law debt are similar (see Erce and Mallucci (2018) and Erce et al. (2022))), as is the case for defaults on foreign- and local-currency debt (see Duggar et al. (2017)).

For the purpose of this analysis, I use CDS spreads for the five-year maturity, which is widely considered to be the most liquid maturity bucket. To help interpret the data, I back out risk-neutral implied default probabilities assuming a constant default hazard rate function.[3]

[3] See Appendix A.1 for the explicit derivation. Since this is a one-to-one transformation of CDS spreads, none of my empirical results would change if I used spreads instead.

Currency risk. To measure currency risk, I use fixed-for-fixed cross-currency swaps (FFFs henceforth) which I take directly from Du and Schreger (2016a). The FFF rate is essentially the long-term equivalent of the interest rate differential implied by exchange rate forwards. Assuming risk neutrality, I interpret this implied rate as a measure of the expected depreciation of a country's currency against the US dollar. Since these instruments are not directly quoted in financial markets, Du and Schreger (2016a) construct them using different combinations—depending on data availability—of fixed-for-floating cross-currency swaps, local currency interest rate swaps, floating-for-floating cross-currency basis swaps, and US dollar interest rate swaps. For reasons of liquidity and consistency with the measure of default risk, I look at five year maturities. I use FFFs, rather than exchange rate forwards, because the latter are generally only quoted for maturities up to 12 months, while the former are liquid for maturities up to 10 years.

Macroeconomic variables. I use data on quarterly, seasonally adjusted real GDP, detrended with a one-sided HP filter with a standard coefficient of 1600.[4] I use this measure to compute the cyclical properties of asset prices and other macroeconomic variables. Inflation is the year-on-year change in the domestic Consumer Price Index (CPI). Exchange rates are nominal, and expressed in units of domestic currency per one US dollar. When I refer to exchange rate depreciation, I mean year-on-year changes in the exchange rate. The national accounting and government finance data I use always consists of ratios of nominal quantities and is thus used without any transformation.

2.2 Long-Run Facts

Let us analyse first the long run relationship between default risk, currency risk, and inflation across countries.

Figure 2 plots averages, taken for each country over the sample period, of default risk, currency risk, and year-on-year CPI inflation. It highlights two cross-country relationships: long-run default risk is positively correlated with both long-run currency risk, as proxied by FFF rates (left panel), and long-run realised CPI inflation (right panel). As Appendix A.2 shows, replacing inflation with exchange rate depreciation yields a very similar picture. In other words, countries with historically high default spreads tend to have high realised inflation, and high realised and expected exchange rate depreciation.

[4]For the GDP filtering process, I do not restrict the data to be in the time window of the rest of the sample and instead use all the available data.

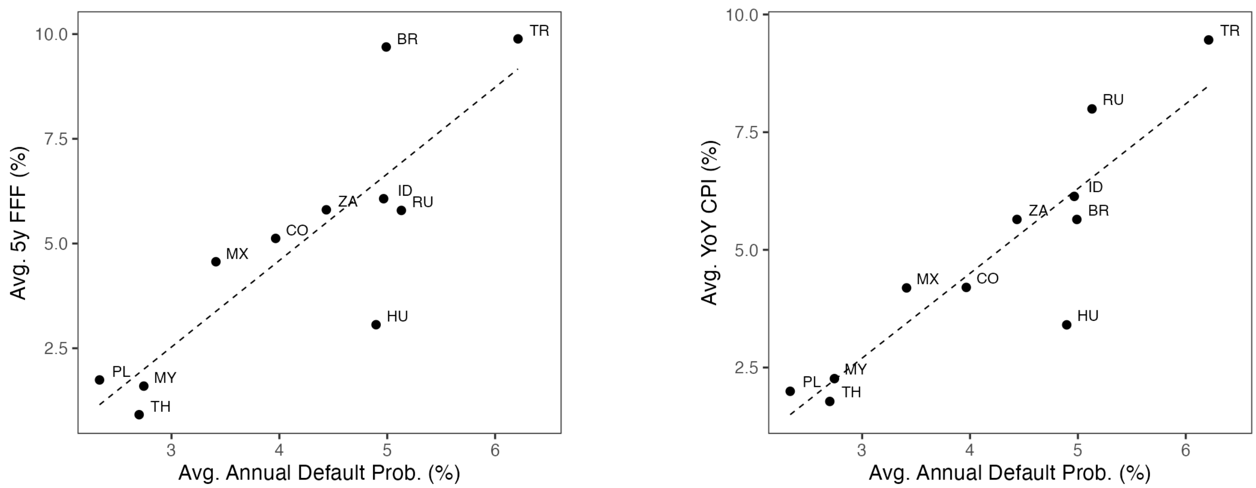

Figure 2: Long-term averages over the sample period. The left panel plots default probabilities against fixed-for-fixed cross-currency swap rates. The right panel plots default probabilities against year-on-year consumer price inflation.

2.3 Short-Run Facts

I now consider the short-run properties of our relationships of interest.

Let us start by looking at simple correlations. Table 1 shows the correlation coefficient between default risk and currency risk, the domestic consumer price index, and the exchange rate. All variables are expressed in year-on-year changes and at a quarterly frequency. Each row shows correlations computed within each country, while the last row of the table shows correlations for the whole sample, i.e. pooling all countries together.[5] The correlation coefficients are all positive and reasonably high, which suggests that default risk comoves with currency risks, inflation and depreciation not only at long-run frequencies, but also in the short-run within each country. I now analyse each column in turn.

Asset price comovement. The first short-run fact concerns the relationship, represented in the second column of Table 1, between default and currency risk as embedded into asset price derivatives.

An obvious concern is that the comovement may be driven by global supply factors that affect foreign investors trading both assets, or by country-specific factors. To address this question, I perform two exercises the details of which can be found in Appendix A.3. First, I estimate a panel regression of FFFs on DPs with time and country fixed effects. Time fixed effects here should account for any common, time-varying factor affecting the relationship between the measures of

[5]Here and in the rest of this section, I use year-on-year changes because asset prices appear non-stationary for most countries in the sample. Results are however very similar when using levels or quarterly changes instead.

Table 1: Short-run correlations within countries.

	Correlation with default spreads		
Country	Cross-currency swaps	CPI inflation	FX depreciation
Brazil	0.74	0.54	0.80
Colombia	0.49	0.46	0.64
Hungary	0.89	0.20	0.43
Indonesia	0.77	0.31	0.62
Malaysia	0.56	0.46	0.43
Mexico	0.52	0.10	0.67
Poland	0.55	0.26	0.53
Russia	0.82	0.46	0.54
South Africa	0.58	0.52	0.78
Thailand	0.31	0.17	0.51
Turkey	0.77	0.48	0.62
Pooled	0.69	0.28	0.57

Notes: Section 2.1 details the construction of the sample and the data moments.

default and currency risk. I get a regression coefficient of 0.707 with a robust standard error of 0.087, which implies that a 1 percentage point increase in the risk-neutral default probability corresponds to a 0.7 percentage point increase in the fixed-for-fixed cross-currency swap rate.

One shortcoming of this approach is that the time fixed effects are assumed to affect each country in the same way. To have a more flexible specification, I estimate a dynamic factor model as a second exercise. This allows for a set of r factors that jointly follow an autoregressive process, and for each country to have different loadings on such factors. Specifically, I estimate the dynamic form

$$\boldsymbol{x}_t = \boldsymbol{C}_0 \boldsymbol{f}_t + \boldsymbol{e}_t$$

$$\boldsymbol{f}_t = \sum_{j=1}^{p} \boldsymbol{A}_j \boldsymbol{f}_{t-j} + \boldsymbol{u}_t$$

where $\boldsymbol{x}_t$ is a 22×1 vector consisting of DP and FFF for each country at time t, $\boldsymbol{f}_t$ is a $r \times 1$ vector of factors at times t, and $\boldsymbol{e}_t, \boldsymbol{u}_t$ are spherical error vectors. The first (measurement) equation assumes that the asset prices of interest are a linear and contemporaneous function of the factors. The second (transition) equation models the factors as a VAR(p) process. I set the number of factors to $r = 3$, which explains around 82% of total variance, and the number of lags to $p = 4$ using the Akaike information criterion. The model is estimated using the Kalman Filter and the

EM algorithm, after transformation to a stacked VAR(1) state-space form. I then run a panel regression on the estimation residuals, and find a statistically significant relationship between default and currency risk, with a regression coefficient of 0.681—remarkably close to the result discussed in the previous paragraph—and a robust standard error of 0.149.

This allows to conclude that the relationship between default and currency risk is robust to controlling for global and country-specific factors, and that a one percentage point increase in the probability of default is linked, on average, with an increase in the expected exchange rate depreciation of around 0.7 percentage points.

Correlation with macroeconomic variables. The second short-run fact concerns the relationship, represented in the third and last columns of Table 1, between default risk and nominal macroeconomic variables, namely realised inflation and exchange rate depreciation. The correlation of default risk with exchange rates is similar in magnitude to that with FFFs, while its correlation with inflation is smaller, although still positive.

Taken together, these facts call for a joint analysis of fiscal aspects, such as default risk, and monetary ones, such as expected and realised inflation and exchange rate depreciation.

3 Model

I consider a quantitative sovereign default model of a small open economy. Time is discrete and infinite. The players are a government, domestic households, and foreign lenders.

Inflation and exchange rates. An important simplifying assumption I make is that there is a single consumption good and the law of one price holds, so domestic price inflation coincides with depreciation of the exchange rate against the rest of the world. Therefore, the moments related to realised and expected inflation in the model will be compared to the facts related to realised inflation and expected currency depreciation in the data.

3.1 Households

Domestic households have the following preferences over private consumption c_t, public consumption g_t, and the net inflation rate π_t between the periods $t-1$ and t:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [u(c_t, g_t) - v(\pi_t)]. \tag{1}$$

Utility over both consumption goods is increasing and concave. The disutility of inflation is assumed to be non-negative, strictly convex, and with a minimum at $v(0) = 0$. The assumption that inflation has a utility cost is a reduced form way to represent the distortions and associated deadweight losses created by inflation.[6]

In this model domestic households do not face any maximisation problem. They receive an exogenous and stochastic stream of income y_t that follows the AR(1) process

$$\log(y_t) = \rho_y \log(y_{t-1}) + \epsilon_t, \quad \epsilon_t \sim N\left(0, \sigma_\epsilon^2\right). \tag{2}$$

A fraction τ_t of such income is paid in taxes to the government. Additionally, household pay an inflation tax $s(\pi_t)$, where the function s is a reduced form way of embedding seigniorage in the model. The household budget constraint is given by

$$c_t + s(\pi_t) \leq y_t(1 - \tau_t). \tag{3}$$

3.2 Government

The government consists of a single policymaker that sets both fiscal and monetary policy. This is equivalent to considering separate fiscal and monetary authorities that share the same objective and act in a coordinated way. The government is benevolent and maximises households' utility (1).

The government enters each period with a real stock of debt b_t and households' income realisation y_t. It can be either in good credit standing or in default, depending on its default history. When it is in good standing, it first chooses whether to default or repay.

Repayment. When it repays, government policy consists in choosing new debt b_{t+1}, inflation π_t, the tax rate τ_t, and public spending g_t. Government debt is assumed to be external, short-term, non-contingent, defaultable, and denominated in local-currency. b_t and b_{t+1} denote the current and future stocks of debt in real terms, that is, divided by the price level at period t. Debt is issued at a price of q_t to a continuum of risk-neutral foreign lenders with deep pockets, who are described below. Inflation is chosen freely by the government in each period, trading off the utility cost with a double benefit: first, inflation reduces the real value of debt; second, it generates seigniorage revenues. The tax rate is also chosen freely, subject to the constraint $\tau_t \leq \overline{\tau}$. The government has thus three sources of revenue: seigniorage and lump-sum taxes,

[6] These could be interpreted as resource costs due to price dispersion or adjustment costs, utility costs in models of money in the utility function or with cash-in-advance constraints, or reputational costs as in Aguiar et al. (2014, 2015).

which are domestic, and debt issuance, which is external. The government budget constraint in period t is given by

$$\frac{b_t}{1+\pi_t} + g_t \leq \tau_t y_t + q_t b_{t+1} + s(\pi_t). \tag{4}$$

Default. If the government decides not to repay, it switches to a default standing. When in default, the government is temporarily excluded from international debt markets, and the domestic economy incurs an output loss that reduces output to $y^D(y_t) \leq y_t$. I assume that default is partial and the length of the exclusion period is random. In all periods that follow a decision to default, with probability θ the government receives a reduction of a share h of its outstanding nominal debt obligations in the previous period, together with a chance to re-enter the debt market. If it accepts, it repays the debt and re-enters debt markets; if it declines, it keeps its default standing, and its outstanding debt remains equal to a fraction $(1-h)$ of the amount due prior to the re-entry offer. This assumption has two implications: first, the debt stock effectively becomes long-term upon a default; second, the government has the option to remain in default for a long enough period of time that its debt obligations become arbitrarily small, as it receives a sufficient number of haircuts. The latter implication is important to ensure that the government always re-enters credit market at some point.

During default periods, the government chooses spending, inflation, and taxes, again subject to the constraint $\tau_t \leq \overline{\tau}$. Inflation here continues to serve an immediate seigniorage purpose, and contributes to the erosion of the real value of debt through the law of motion for debt $b_{t+1} = \frac{b_t}{1+\pi_t}$. The budget constraint of the government during periods of default is

$$\tau_t \, y^D(y_t) + s(\pi_t) = g_t. \tag{5}$$

Taxes. Since output is exogenous, taxes in this model are lump-sum and thus non-distortionary. For this reason, the upper bound on the tax rate $\overline{\tau}$ has an important role in limiting how much frictionless revenue the government can raise domestically. I will consider two versions of the model: one in which the tax constraint is high enough that it never binds, so the government is unrestricted in the use of lump-sum taxation (the "baseline" model), and another where the tax constraint binds (the "constrained" model).

Market clearing. Combining the budget constraint of the households and the government we get the domestic economy's resource constraint in repayment periods

$$y_t - c_t - g_t = \frac{b_t}{1+\pi_t} - q_t b_{t+1}, \tag{6}$$

which says that the trade balance (left-hand side) must equal next capital flows (right-hand side), and in default periods

$$y^D(y_t) - c_t - g_t = 0. \tag{7}$$

3.3 Foreign Lenders

Government debt is issued to a continuum of risk-neutral, perfectly competitive foreign lenders with deep pockets. They have an opportunity cost of funds equal to the international gross risk-free rate R^*, which I assume constant for simplicity.

They are indifferent with respect to the amount of government bonds they buy, as long as they make zero profits in expectation. The zero-profit price of a unit of government debt is given by

$$q_t = \frac{1}{R^*}\mathbb{E}_t\left[\frac{1-\delta_{t+1}}{1+\pi^R_{t+1}} + \frac{\delta_{t+1}\ q^D_{t+1}}{1+\pi^D_{t+1}}\right]$$

where δ_{t+1} is a default indicator that takes the value of 1 if the government chooses to default at $t+1$ and zero otherwise, π^R_{t+1} and π^D_{t+1} respectively denote the net inflation rate between t and $t+1$ conditional on repayment and default in $t+1$, and q^D_{t+1} denotes the price of debt upon default in period $t+1$, which I analyse more in detail in Section 3.4.

From the price of new debt, it is easy to derive the model counterparts of the default and currency risks I analysed in the empirical section. Default expectations are given by

$$\mathrm{DP}_t := \mathbb{E}_t[\delta_{t+1}],$$

while expected inflation (or exchange rate depreciation, which are identical in the model) are given by

$$\mathrm{FFF}_t := \mathbb{E}_t[\delta_{t+1}\pi^D_{t+1} + (1-\delta_{t+1})\pi^R_{t+1}],$$

which shows that inflation spreads are jointly driven by the government default policy as well as the inflation policy upon repayment and default.

3.4 Recursive Formulation and Equilibrium

I consider the time-consistent Markov-perfect equilibrium where the government internalises the effect of its current policy on future government policy and debt prices, which are taken as given.

I drop time subscripts and move to the recursive formulation of the problem, where x and x' respectively indicate the current and future value of variable x. In the model there is one exogenous state variable, given by the output shock y, and two endogenous states: the real stock of government debt b, and the default standing. To denote the latter, rather than using an explicit state variable, I use different value functions depending on whether the government is in default or repayment states. In a Markov equilibrium, government policies and equilibrium prices only depend on the value of the current aggregate state variables.

Government problem. I now characterise the recursive problem of the government. The value of a government that has the option to default is given by

$$V(b, y) = \max_{\delta \in \{0,1\}} \left\{(1-\delta)V^R(b, y) + \delta V^D(b, y)\right\}$$

where $V^R(b, y)$ and $V^D(b, y)$ respectively denote the value of repayment and default. When in good credit standing, the value of the government is given by

$$\begin{aligned} V^R(b, y) = \max_{c,g,\pi,\tau,b'} \ & \Big\{u(c, g) - v(\pi) + \beta \mathbb{E}\left[V(b', y') \mid y\right]\Big\} \\ \text{s.t.} \quad & \frac{b}{1+\pi} + g = \tau y + q(b', y)b' + s(\pi) \\ & c + g = y - \frac{b}{1+\pi} + q(b', y)b' \\ & \tau \leq \overline{\tau}. \end{aligned} \tag{8}$$

When in bad credit standing, the value of the government is given by

$$\begin{aligned} V^D(b, y) = \max_{c,g,\pi,\tau} \ & \left\{u(c, g) - v(\pi) + \beta\, \mathbb{E}\left[\theta\, V\left(\frac{b(1-h)}{1+\pi}, y'\right) + (1-\theta)\, V^D\left(\frac{b}{1+\pi}, y'\right)\right]\right\} \\ \text{s.t.} \quad & \tau y + s(\pi) = g \\ & c + g = y^D(y) \\ & \tau \leq \overline{\tau}. \end{aligned} \tag{9}$$

I can now define the recursive equilibrium of the economy.

Definition 1 (Markov-Perfect Equilibrium). *A Markov-perfect recursive equilibrium consists of*

- *government value functions* V, V^R, V^D
- *associated policy functions* δ, g, τ, π, b'
- *debt price functions* q, q^D

such that:

1. *value and policy functions solve the government problem, given the debt price functions;*
2. *the debt price functions solve the lenders' problem, given the government value and policy functions.*

Debt prices. Given the equilibrium policy functions, we can rewrite equilibrium debt prices in recursive form. The price of a unit of new debt is

$$q(b', y) = \frac{1}{R^*} \mathbb{E} \left[\frac{1 - \delta(b', y')}{1 + \pi^R(b', y')} + \frac{\delta(b', y')\, q^D(b', y')}{1 + \pi^D(b', y')} \right],$$

which implies that the expressions for inflation and default spreads are respectively given by

$$\mathrm{DP}(b', y) = \mathbb{E}[\delta(b', y') \,|\, y] \tag{10}$$

and

$$\mathrm{FFF}(b', y) = \mathbb{E}\left[\delta(b', y') \pi^D(b', y') + \Big(1 - \delta(b', y')\Big) \pi^R(b', y') \,|\, y \right]. \tag{11}$$

The price of a unit of defaulted debt is

$$q^D(b, y) = \frac{1}{R^*} \mathbb{E}_t \left[(1 - \theta) \frac{q^D\left(s'_n\right)}{1 + \pi^D\left(s'_n\right)} + \theta(1 - h) \left(\frac{\delta(s'_o) q^D(s'_o)}{1 + \pi^D(s'_o)} + \frac{(1 - \delta(s'_o))}{1 + \pi^R(s'_o)} \right) \right] \tag{12}$$

where $s'_o = \left(\frac{b(1-h)}{1+\pi(b,y)}, y \right)$ and $s'_n = \left(\frac{b}{1+\pi(b,y)}, y \right)$ respectively denote the future state when the sovereign is with and without a restructuring offer on hand.

4 Model Analysis

In this section, I characterise the optimal policy for the government. To make expressions more readable, I sometimes omit the arguments of policy and price functions.

4.1 Tax and Inflation Policy

When the government is in good credit standing, the following two equations summarise the optimality conditions for private and public consumption, inflation, and tax policy, as well as the complementary slackness condition for the tax constraint:

$$(u_g - u_c)(\overline{\tau} - \tau) = 0 \tag{13}$$

$$u_g \frac{b}{(1+\pi)^2} + s'(\pi)(u_g - u_c) = v'(\pi). \tag{14}$$

Equation (13) says that whenever the marginal utility of private and public good consumption are not equalised, it must be that the tax constraint is binding. On the other hand, when the optimal tax rate is such that the constraint is slack, then $u_g = u_c$ and the economy is at the constrained first-best.[7]

Equation (14) equates the marginal benefit of inflation (on the left-hand side) to its marginal cost (on the right-hand side). The benefit consists of two terms. First, inflation dilutes the real value of debt, and the strength of this channel is positively related to the size of the debt stock and the marginal utility of public consumption. Second, inflation helps to transfer resources from the private to the public sector through seigniorage, which is valuable only if such transfer cannot be made in a frictionless way via lump-sum taxes. That is, when taxes are unconstrained, the marginal utility of private and public consumption is equalised and the only benefit of inflation is to dilute the real value of debt.[8] When instead lump-sum taxes are constrained, seigniorage becomes important in raising revenues for the government to fund government spending, and its value is higher, the higher the wedge between u_g and u_c.

As I will show in detail later, debt levels are procyclical, while the marginal utility of spending and its difference with that of private consumption are countercyclical. The relative strength of these forces is crucial in determining the cyclicality of realised inflation, as well as the correlation between default and inflation spreads. In the baseline model, I follow the literature and assume that lump-sum taxation is unconstrained and the curvature of the utility function is relatively low. As a result, the seigniorage motive is muted, and the dilution motive is driven more by debt levels than by u_g, making inflation spreads procyclical. In the constrained model, I set a constraint on taxes and assume that the utility of public spending has a higher curvature. This implies that the tax constraint binds and u_g is countercyclical, and more so than u_c. This introduces a seigniorage motive for inflation, and makes u_g a stronger driver of the dilution motive.

[7]That is, the *domestic* economy is at the first best, and the only frictions present are the sovereign's lack of commitment to repay and the deadweight cost of inflation.

[8]Of course, inflation will still generate a (unnecessary) resource transfer from the private to the public sector, but this can be offset with the use of lump-sum taxes or transfers.

Implicit versus explicit default. It is worth discussing briefly the difference between the two options the sovereign has for reducing its debt stock. One is inflation, which is an implicit form of default and is assumed to be a continuous instrument with convex costs, allowing the country to reduce the real value of debt while remaining connected to debt markets. The second option is explicit default, which is a binary action with two fixed costs: a deadweight output loss and exclusion from international financial markets. Absent any other motive for the use of inflation, these two options are perfect substitutes because they accomplish the same objective while having different costs and action sets: the sovereign will resort to implicit default when the cost of debt repayment is high but not prohibitive, and to explicit default when its fixed cost is smaller than that associated to large levels of inflation.

4.2 Intertemporal Policy

Repayment periods. When the government is in good credit standing, new debt issuance is the only intertemporal choice for the government. The Euler equation for b' is

$$\left(q + \frac{\partial q}{\partial b'} b'\right) u_g = \beta\, \mathbb{E}\left[V_b(b', y')\right]. \tag{15}$$

The left-hand side is standard and says that the marginal benefit of debt issuance is given by its marginal revenue, accounting for the price effect, evaluated at the current marginal utility of public consumption. The right-hand side represents the expected future marginal cost of debt, which can be expressed recursively as

$$\mathbb{E}[V_b(b', y')] = \mathbb{E}\left[(1-\delta')\, V_b^R(b', y') + \delta'\, V_b^D(b', y')\right],$$

where V_b is the partial derivative of value function V with respect to debt, and

$$\begin{aligned} V_b^R(b, y) &= -\frac{u_g}{1+\pi^R(b, y)} \\ V_b^D(b, y) &= \frac{\beta}{1+\pi^D(b, y)} \mathbb{E}\left[\theta(1-h) V_b\left(\frac{b(1-h)}{1+\pi^D(b, y)}, y'\right) + (1-\theta) V_b^D\left(\frac{b}{1+\pi^D(b, y)}, y'\right)\right]. \end{aligned}$$

It is possible to rearrange this expression and substitute out all value functions by rewriting the future marginal cost of debt as the infinite sum of all future products of real debt values and marginal utilities of spending. Mathematically and using sequence notation

$$\mathbb{E}_t\left[V_b(b_{t+1}, y_{t+1})\right] = \mathbb{E}_t\left[\sum_{k=1}^{\infty} \beta^k \chi\left(s_{t+1}^{t+k}\right) u_g(s_{t+k})\right] \tag{16}$$

where $s_{t+1}^{t+k} := \{s_{t+1}, s_{t+2}, \ldots, s_{t+k}\}$ denotes the history of states between $t+1$ and $t+k$; $s_{t+k} := (b_{t+k}, y_{t+k}, \omega_{t+k})$ denotes the set of states in period $t+k$; ω_{t+k} is an indicator that takes value of one if the government is in repayment or has a re-entry option while in default, and zero otherwise; and $\chi(s_{t+1}^{t+k})$ is a function that computes the discounted, expected real value of debt at the end of history s_{t+1}^{t+k}, taking into account all haircuts and inflation debt debasements along that history, that is

$$\chi\left(s_{t+1}^{t+k}\right) := \mathrm{P}(s^{t+k}|s_t)\left(\prod_{j=1}^{k-1}\frac{1-\omega_{t+j}+\omega_{t+j}(1-h)\delta(s_{t+j})}{1+\pi^D(s_{t+j})}\right)\frac{\omega_{t+k}(1-h)\Big(1-\delta(s_{t+k})\Big)}{1+\pi^R(s_{t+k})}. \tag{17}$$

The interested reader can find more details in Appendix B.2.

Default periods. When the government is in default, its only intertemporal choice is inflation, which has no immediate effect but serves to reduce the real value of the debt payment that the government must eventually make to regain access to international debt markets when it receives *and* accepts the offer to do so. The FOC for inflation is

$$v'(\pi) = \beta\frac{b}{(1+\pi)^2}\mathbb{E}\left[\theta(1-h)V_b\left(\frac{b(1-h)}{1+\pi}, y'\right) + (1-\theta)V_b^D\left(\frac{b}{1+\pi}, y'\right) \mid y\right] \tag{18}$$

where $\pi \equiv \pi^D(b, y)$ is the inflation policy in the current period. Using (17) we can substitute out the value functions and express the expected future marginal benefit of inflation (i.e., the right-hand side of (18)) as

$$v'(\pi_t) = \frac{b_t}{(1+\pi_t)^2}\mathbb{E}_t\left[\sum_{k=1}^{\infty}\beta^k\chi\left(s_{t+1}^{t+k}\right)u_g(s_{t+k})\right].$$

The assumption that default is partial creates a role for inflation upon default, and thus the possibility that the expected inflation of (11) is at least partly driven by it. Nevertheless, below I show that π^D is quantitatively very small and has no role in driving inflation spreads.

5 Quantitative Evaluation

I now describe the model parametrisation and its quantitative performance. The reference country I choose for the calibration among the countries in the sample is Brazil, which I consider representative because it is a large EM sovereign with a large share of local-currency debt, and is a popular calibration target among recent papers in the literature, which should allow the reader for an easier comparison.

Parametrisation and functional forms. A period is a quarter. Table 2 shows the parameters that are chosen externally. Preferences are assumed to follow the functional form

$$u(c,g) - v(\pi) = \frac{c^{1-\gamma}}{1-\gamma} + \alpha_g \frac{g^{1-\eta}}{1-\eta} - \alpha_\pi \frac{\pi^2}{2}. \tag{19}$$

The curvature of the utility from private consumption γ is set equal to 2, a standard value in the quantitative sovereign default literature. The curvature η of the public good utility is an important parameter in the model as it determines the relative volatilities of private and public consumption, and in turn the incentive for the government to collect fiscal revenues via seigniorage if and when lump-sum taxes are constrained. The values I choose for this parameter are different in the baseline and the constrained model, so I postpone its discussion to where I discuss each model separately. For the utility cost from inflation I assume a simple increasing and convex function; at the end of Section 5.2 I discuss the implications of making such cost depend on output, possibly in a non-linear way.

The seigniorage function is chosen, following Calvo (1988) and Corsetti and Dedola (2016), assuming a constant demand for real money balances, and is given by $s(\pi) = \kappa\frac{\pi}{1+\pi}$, where $\kappa = 0.676$ is set to match the average level of the extended monetary base as a ratio of GDP.[9] I estimate the output process (2) and obtain parameters $\rho_y = 0.8733$ and $\sigma_\epsilon = 0.0086$. The costs of default are assumed to follow the standard, non-linear functional form

$$y^D(y) = y - \max\{0, d_0 y + d_1 y^2\}.$$

The international risk-free rate is set to the average annualised nominal rate on 5-year US Treasuries. The probability of re-entry is taken from Arellano (2008) and is set to 0.282, which implies an average exclusion from credit markets of about 3.5 quarters. This is admittedly a short period of time, but is chosen among the available estimates to give the benchmark model the best possible chance to generate high inflation upon default. The default recovery rate is taken from Cruces and Trebesch (2013).[10]

Solution method. I follow Gordon (2019), Dvorkin et al. (2018), and Arellano et al. (2020) and use taste shocks to render the probability distribution of the government debt and default choices non-degenerate. This is not strictly necessary in the current version of the model, but

[9] This assumption is made for simplicity and to make the results transparent. The model can be extended to the case where money demand is a function of the domestic interest rate.

[10] Erce et al. (2022) show that average recovery rates for domestic-and foreign-law debt are 62% and 59% respectively, which are slightly lower than those in Cruces and Trebesch (2013). It is worth noting that the convention in the CDS industry is to assume significantly lower recovery rates of 40% and 25% for senior unsecured credit in advanced and emerging market economies, respectively.

Table 2: Parameters chosen externally.

Variable	Symbol	Value	Source
Risk-aversion coefficient	γ	2	Conventional value
International risk-free rate (% annualised)	$R^* - 1$	2.6528	US Treasury rate
Log-output autocorrelation coefficient	ρ	0.8733	estimated
Log-output innovation standard deviation	σ_ϵ	0.0086	estimated
Re-entry probability	θ	0.282	Arellano (2008)
Debt recovery rate upon default	$1 - h$	0.63	Cruces and Trebesch (2013)

substantially improves its convergence properties. Appendix C explains how this approach is implemented in detail. I solve the model numerically on Julia using value function iteration (VFI), which I parallelise on a GPU. To do so, I build on Deng et al. (2023) and extend their work by adding taste shocks and an extra maximisation problem (the optimal inflation policy) inside the inner step of the VFI. I solve the model on an Intel Core i7-9700 CPU and a NVIDIA GeForce RTX 3060 Ti GPU. Using 101 gridpoints for debt and 35 for output, solving and simulating the model takes 1 second on the GPU, 16.5 seconds on the CPU with multithreading, and 83 seconds on the CPU without any parallelisation.[11]

5.1 Baseline Model

I now discuss the parametrisation, calibration, and quantitative performance of the baseline model.

Utility curvature. First, I set $\gamma = \eta$ so that the utility of private and public consumption has the same shape. Second, I assume that tax policy is unconstrained, so there never is a wedge between the marginal utilities of private and public consumption. This implies that the ratio between c and g is constant, and I set the utility parameter $\alpha_g = 0.0893$ to exactly match their average ratio in the data. These assumptions are made so that the baseline model closely follows the workhorse model of the quantitative sovereign default literature, and its extension to nominal debt as in Aguiar et al. (2013), Aguiar et al. (2015), Hurtado et al. (2022). This can be verified by referring to optimality conditions (13), (14) and (15) when $u_g = u_c$: the government is effectively facing a social planning problem domestically, and chooses external debt, default and inflation to smooth household consumption over time, subject to lack of commitment and

[11]The processor and GPU mentioned are admittedly quite old, roughly five years old at the time of writing. For comparison, solving and simulating the model on a 14-cores Apple M4 Pro takes 5.2 seconds on the CPU with multithreading, and 38.8 seconds on the CPU without any parallelisation. Hence, using a five years old, mid-range graphic card is still five times faster than a recent, high-end laptop processor.

inflation costs.

Targeted moments. Table 3 illustrates the remaining four parameters that are calibrated internally: the discount factor β, the inflation cost parameter α_π, and the two default cost parameters d_0, d_1. These are chosen to match average external debt, the average inflation rate, and the mean and standard deviation of the annual default probability, which I back out of CDS contracts as explained in Section 2.1.[12] The values of parameters d_0, d_1 respectively imply output losses of 1.88% and 4.35% when output is at its median and maximum value.

Table 3: Parameters selected to match targets.

Variable		Value	Target	Data	Model
Discount factor	β	0.926	External debt/GDP (mean)	8.66	8.66
Inflation cost parameters	α_π	5.215	YoY CPI Inflation (mean)	5.64	5.64
Default cost parameter	d_0	-0.318	Annual default prob. (mean)	4.99	4.99
Default cost parameter	d_1	0.337	Annual default prob. (st. dev.)	2.33	2.33

Notes: All moments are expressed in percentage terms. Section 2.1 details the construction of the sample and the data moments.

Non-targeted moments. Table 4 shows the performance of the model with respect to a number of non-targeted moments of interest. The first line displays the correlation between default spreads (DP_t), and inflation spreads (i.e., the expected inflation implied in the price of government debt, FFF_t), which are the model equivalent of the cross-currency swap rates analysed in the empirical section of the paper.[13] The benchmark model delivers a negative correlation between these two asset prices, which is at odds with what I observe in the data. The reason for this is that, in this model, both expected and realised inflation are procyclical, while default spreads are countercyclical. As a result, default spreads and realised inflation are negatively related, which is also at odds with the empirical evidence.

Equilibrium policy and asset prices. Figure 3 illustrates the behaviour of a few key equilibrium variables, as a function of output (on the horizontal axis) and of three levels of

[12]Since the model is quarterly, I compute the expected *annual* default probability in period t as the probability of observing a default in the following four quarters, that is,

$$\mathrm{DP}_t = \mathbb{E}_t \left[\sum_{k=1}^{4} \prod_{j=1}^{k-1} (1 - \delta_{t+j}) \delta_{t+k} \right].$$

[13]See equations (10) and (11) for the explicit definitions.

Table 4: Non-targeted moments, baseline model.

Moment	Model	Data
$\rho(\mathrm{DP}_t, \mathrm{FFF}_t)$	-0.41	0.46
$\rho(\mathrm{DP}_t, y_t)$	-0.61	-0.71
$\rho(\mathrm{DP}_t, \pi_t)$	-0.30	0.63
$\rho(y_t, \mathrm{FFF}_t)$	0.94	-0.59
$\rho(y_t, \pi_t)$	0.73	-0.76
$\sigma(\pi_t)$	1.46	1.84

Notes: Data moments are computed using asset prices in levels. Section 2.1 details the construction of the sample.

initial real debt (denoted by different colours, and given by the average level of debt and two other values that are one standard deviation above and below the mean). Thick and thin lines respectively denote variables during repayment and default periods. The top-centre panel plots the policy function for new real debt issuance, highlighting a standard feature of sovereign default models: debt is strongly procyclical, which means that the government experiences capital flows (top-right panel) that are positive in booms and negative in recessions. This is consistent with empirical findings on the cyclicality of the trade balance in emerging market economies.

As discussed in Section 4.1, in this version of the model inflation only serves the purpose of manipulating the real value of debt. The incentive to do so is driven by two forces. First, the size of the debt stock determines the power of the debt inflation instrument, and is procyclical. Second, the marginal utility of public spending determines the value of shifting resources from debt service to spending, and is countercyclical. The top-left panel of Figure 3 shows that the former mechanism is quantitatively stronger than the latter, as the inflation policy function in repayment (thick lines) is more sensitive to debt than to output.[14]

Thin lines plot inflation policy upon default. In this model, inflation incentives during default are negligible because inflation costs far outweigh its benefit—diluting the real value of debt in light of a future chance to re-enter markets. This will be the case even in the constrained model, despite the additional purpose that inflation will serve in both repayment and default periods.

The bottom-left and bottom-centre panels of Figure 3 plot, respectively, the annual expected default and inflation associated with the equilibrium debt policy. As is commonly found in the literature, default spreads are countercyclical because the government has stronger incentives to borrow in bad times, but output persistence makes the debt price schedule less favourable as a future default is more likely. Inflation expectations are instead procyclical because inflation

[14] That is, inflation responds more strongly to a one-standard-deviation change in debt than to an equally sized change in output.

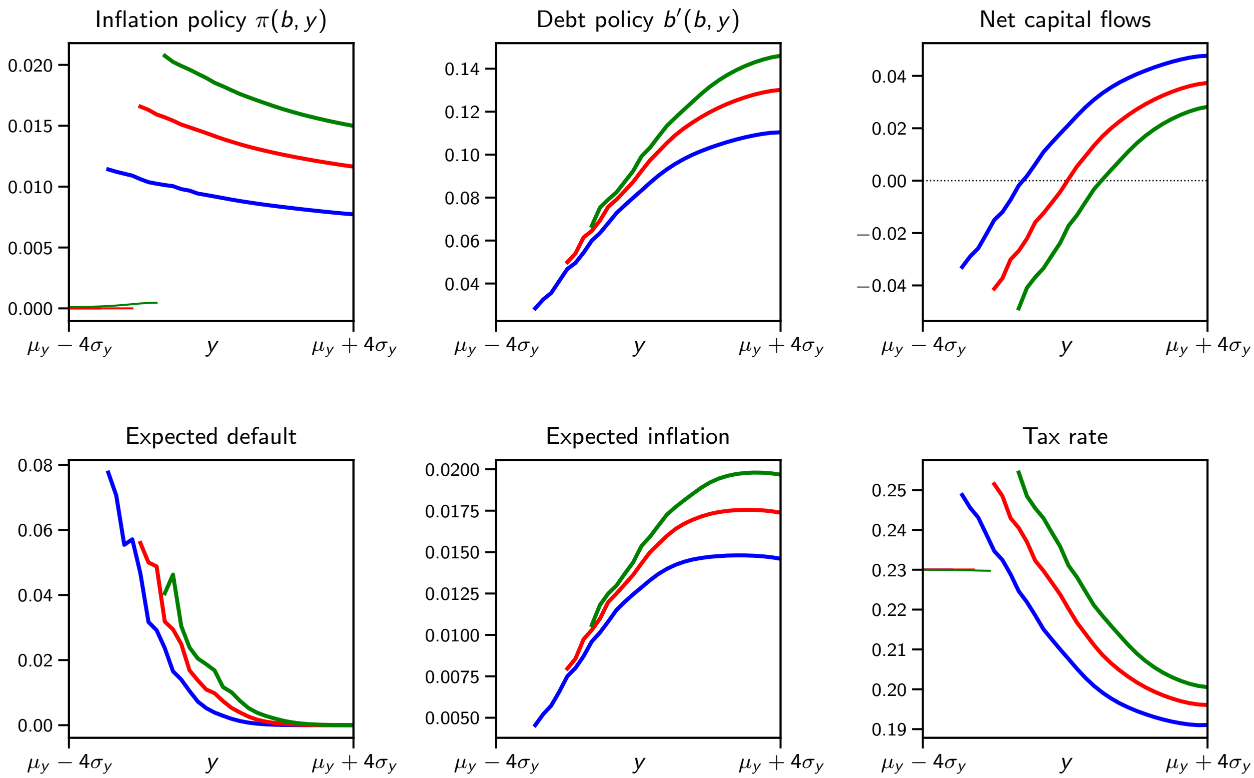

Figure 3: Equilibrium policies and asset prices for the baseline model. Thick and thin curves respectively denote repayment and default periods. Blue, green, and red curves represent debt levels one standard deviation below, above, and equal to the simulation average.

incentives are closely linked to debt levels, as explained in the previous paragraph. As a result, inflation and default spreads are negatively related, which is counterfactual: if inflation only serves as an implicit default instrument, the very features at the core of sovereign default models imply they are at odds with the data along a number of important real and financial dimensions.

Finally, the bottom-right panel of Figure 3 plots the lump-sum tax rate τ. Total transfers from the private to the public sector are given by lump-sum plus seigniorage tax revenues. In the absence of both forms of taxation, g would be given by net capital inflows (i.e., the negative of the trade balance $qb' - b/(1+\pi)$), and $c = y$. During default periods the sovereign is in autarky, so the tax rate is equal to the c/g ratio, which is constant in this model.[15] In periods of repayment, the cyclicality of taxes is purely driven by that of the trade balance: when the government receives large inflows of capital, there is less of a need to tax private output to finance g, and vice versa when there are large outflows. The tax rate depends on this force as well as the cyclicality of seigniorage, which is less volatile than the trade balance in this model, so tax rates follow the latter.

[15] With $\gamma = \eta = 2$, we have that $g/c = \sqrt{\alpha_g}$, which implies that the autarky tax rate is $\tau = \frac{\sqrt{\alpha_g}}{1+\sqrt{\alpha_g}}$.

5.2 Constrained Model

I now consider the quantitative implications of modifying the baseline model along two dimensions. First, I allow the upper bound on the tax rate to be low enough to bind. Second, I assume that the curvature of the utility from public good consumption is higher than that of private consumption. The rationale behind these assumptions is the following. A binding tax constraint introduces the additional incentive for the government to use inflation as a source of tax revenue, to finance spending when the tax constraint binds. The strength and cyclicality of this incentive is then determined by the motive to transfer resources from the private to the public sector, which I discussed in the previous section. However, the presence of inflation costs makes the taxation motive weaker once a larger part of tax revenues comes from costly inflation rather than frictionless lump-sum taxes. The assumption of a higher curvature in the utility of public good consumption counteracts this force, making both the taxation and the debt debasement motives for inflation stronger in bad times, when the marginal utility of public spending is high both in absolute terms and relative to that of private consumption.

Importantly, neither of these two assumptions alone would be sufficient to change the counterfactual properties of the baseline model analysed above: after re-calibrating such model with either $\eta = 4$ or a (possibly binding) $\overline{\tau}$, I find that the debt debasement motive remains the stronger force, inflation remains procyclical, and default and inflation risk remain negatively correlated.

Table 5: Parameters selected to match targets.

Variable	Parameter	Value	Target	Data	Model
Discount factor	β	0.883	External debt/GDP (mean)	8.66	8.66
Inflation cost constant	α_π	11.405	YoY CPI Inflation (mean)	5.64	5.64
Public good utility constant	α_g	0.0053	c/g ratio	29.88	29.88
Default cost parameter	d_0	-0.265	Default prob. (mean)	4.99	4.99
Default cost parameter	d_1	0.282	Default prob. (st. dev.)	2.33	2.33
Tax rate ceiling	$\overline{\tau}$	0.221	YoY CPI Inflation (st. dev.)	1.84	1.86

Notes: All moments are expressed in percentage terms. Section 2.1 details the construction of the sample and the data moments.

Targeted moments. As in the baseline model, parameters are chosen to match a number of targets, as illustrated by Table 5. Here we have two more parameters than in the baseline model: the tax rate constraint $\overline{\tau}$, and the curvature of the utility of public good consumption η. I set $\overline{\tau}$ to match the standard deviation of inflation, and $\eta = 4$. The latter is chosen for convenience, since it makes the resource constraint conditional on (b, b', π) a quadratic equation in g which can be solved efficiently, and is high enough for the asset price correlations to reverse.[16] The values of parameters d_0, d_1 respectively imply output losses of 1.76% and 3.82% when output is at its median and maximum value.

Non-targeted moments. Table 6 displays the model performance with respect to the same non-targeted moments against which I evaluated the baseline model in the previous section. The model now performs better in matching several features of the data: default and inflation risks comove, default spreads remain countercyclical, and realised inflation correlates positively with default risk and negatively with the cycle.

Table 6: Non-targeted moments, constrained and baseline models.

Moment	Constrained Model	Baseline Model	Data
$\rho(\text{DP}_t, \text{FFF}_t)$	0.45	-0.41	0.46
$\rho(\text{DP}_t, y_t)$	-0.64	-0.61	-0.71
$\rho(\text{DP}_t, \pi_t)$	0.46	-0.30	0.63
$\rho(y_t, \text{FFF}_t)$	0.07	0.94	-0.59
$\rho(y_t, \pi_t)$	-0.38	0.73	-0.76
$\sigma(\pi_t)$	1.84	1.46	1.84

Notes: Data moments are computed using asset prices in levels.
Section 2.1 details the construction of the sample.

Equilibrium policy and asset prices. Figure 4 is the counterpart of Figure 3 for the constrained model, and plots policy functions and equilibrium prices in repayment periods as a function of output (on the x-axis) and three levels of initial real debt (denoted by different colours, and given by the average level of debt and two other values that are one standard deviation above and below the mean). Solid lines represent the constrained model, while the semi-transparent dashed lines plotted in the background show the baseline model for comparison. The figure is helpful to see what are the main drivers of the change in the model performance.

Debt policy and net capital flows show little change and remain procyclical. The reason is that the government would like to borrow more in times of low output, but it does not because the rise in default spreads more than offsets the consumption smoothing motive. This is analogous to what happens in the baseline model. The key difference here is that, in bad times, spending cannot be financed by lump-sum taxes because the tax constraint is binding. The government thus uses seigniorage as an alternative source of tax revenues, and has a strong motive to do so

[16] When the tax constraint does not bind, $u_g = u_c$ implies $c = g^{\eta/\gamma}\alpha_g^{-1/\gamma}$. Assuming $\gamma = 2$ and $\eta = 4$, that becomes $c = g^2/\sqrt{\alpha_g}$.

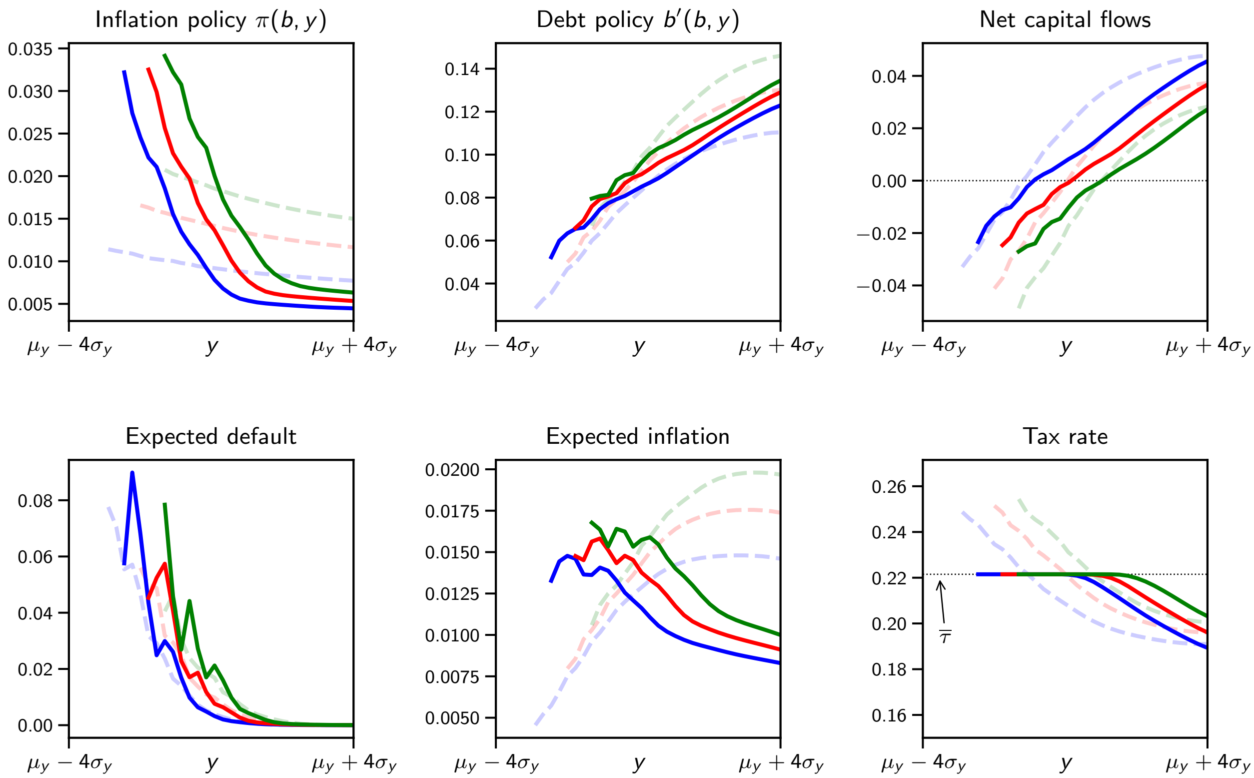

Figure 4: Equilibrium policies and asset prices for the baseline model (solid semi-transparent lines) and the constrained model (dashed lines). Blue, green, and red curves represent debt levels one standard deviation below, above, and equal to the simulation averages.

because the marginal utility of spending in these states is high. It follows that the tax motive behind inflation is stronger than the debt debasement motive, which was the only force present in the baseline model. As the inflation policy panel shows, inflation becomes more responsive to output than to debt levels, especially when the former is low and the tax constraint binds. As a result, both realised and expected inflation are higher in bad times, which flips the sign of their correlation with default spreads, making the model consistent with the data.

Discussion of alternative assumptions. There are essentially two ways to reverse the negative correlation between inflation and default spreads and reconcile the baseline model with the data: making inflation during repayment sufficiently countercyclical, and assuming that inflation upon default is larger than in repayment. I now discuss each mechanism in turn.

First, as inflation incentives become stronger in times of low output, the optimal inflation policy for the sovereign becomes more sensitive to the cycle and less to debt levels, thus making default and inflation spreads comove, and realised inflation countercyclical. This paper achieves this result by assuming that the government has a strong desire to smooth public good consumption, and an incentive to resort to seigniorage in bad times. A reduced-form way of achieving the same result would be to let the utility cost of inflation also depend on output, possibly in a nonlinear way. Consider for example the functional form used by Hurtado et al. (2022) and given by $v(\pi) = \alpha_\pi \frac{\pi^2}{2} y^\xi$, which nests the baseline calibration in this paper when $\zeta = 0$.[17] The question then becomes what values of ξ are both reasonable and sufficient to match the data. Using the baseline calibration of Table 3, I find that extremely large values of ξ are needed to get satisfying results: for example, setting $\xi = 13$ brings the spreads correlation from negative to zero and makes inflation mildly countercyclical, while a higher value of $\xi = 18$ delivers a spreads correlation of 0.4 and a correlation between inflation and the cycle of -0.45, as in the constrained model and in the data. To put these numbers in context, Appendix B.1 shows that, to make the behaviour of inflation in this model equivalent to what one would get in a model of price adjustment costs à la Rotemberg (1982), one would need to set $\xi \approx -1$.

The second mechanism works through inflation upon default. When this is large, an increase in the probability of default automatically implies an increase in expected inflation, as shown by equation (11). In this paper, the incentive to use inflation—as a source of fiscal revenues and as implicit default—is much weaker when in default than when in repayment but close to the default frontier: in the latter case, the sovereign has higher debt stocks and stronger funding needs (due to capital outflows) than in the case of default and autarky. As a result, inflation upon default is small and does not drive the correlation between spreads.[18] In fact, this paper shows that the behaviour of inflation upon repayment in the constrained model is consistent with the data on realised inflation on one hand, and is sufficient to make the model-implied correlation between default and inflation spreads match the data on the other hand. In this sense, the paper differs from—and is complementary to—Arellano et al. (2020) and Maeng (2024), where high inflation upon default is a key driver of realised and expected inflation when the sovereign is in repayment states close to the default frontier. Specifically, in these papers price stickiness implies that low TFP in default states raises inflation through a standard New Keynesian Phillips Curve mechanism. They also show that the alternative assumption of a looser monetary policy stance in default achieves the same goal.

6 Conclusion

This paper studies in detail the relationship between strategic inflation, default and inflation risk. In the data, default risk for a set of EM sovereigns is sizeable and positively related to realised and expected inflation. A simple model of default and debt dilution via inflation has

[17] Hurtado et al. (2022) set $\xi = 27.8$.

[18] Even though I do not plot inflation upon default in Figure 3 to keep it readable, it is essentially unchanged from the baseline model, so it is not the driver of the change in the behaviour of inflation spreads.

a difficult time in matching these facts because inflation and default are essentially substitutes. To reconcile the model with the data, it is important that inflation also serves a second purpose: that of generating fiscal revenues, which is especially useful in bad times and during periods of autarky.

The model I develop allows to quantitatively evaluate the trade-off between the insurance benefits and the time-inconsistency costs of issuing debt in domestic currency, showing that the way in which default and inflation risks move is crucial in this regard. In light of this, the paper offers a natural starting point to study the interplay between fiscal-monetary interactions and the welfare benefits of local-currency debt.

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A Data Appendix

A.1 CDS-Implied Default Probabilities

To extract default probabilities from CDS spreads, I follow the finance and asset pricing literature and model default as the first jump of a (potentially inhomogeneous) Poisson process, with $\lambda(t)$ denoting the default intensity or hazard rate function. $\lambda(t)$ thus represents the probability that default happens at time t, conditional on not having happened before. In turn, the survival probability is given by

$$S(t) = e^{-\int_0^t \lambda(u)du} \tag{A.1}$$

which becomes $S(t) = e^{-\lambda t}$ if the hazard rate is assumed constant.

A CDS contract is composed of two legs, the premium leg and the protection leg. The premium leg consists of periodic payments of a premium expressed in percentage terms of the notional, also called par spread, until maturity or the default event, whichever comes first. The protection leg consists of a one-off payment of the haircut (or loss) given default if default occurs before maturity, or nothing otherwise.

Let us write down the pricing formulas for both legs. In doing so, I adopt the following simplifying assumptions: interest rates, default intensity and recovery rate are independent, and the premium leg pays the spread continuously until default (otherwise one would need to consider premium arrears to be paid upon default). Let U_{par} represent the par spread, $\text{DF}(t)$ the risk-free discount factor used to discount a period-t cash-flow back to time 0, T_1 the time of default (i.e. the first jump of the Poisson process), T the instrument maturity, and $S(t)$ the survival probability up to t.

The present value (PV) of the premium leg is given by the present value of all premium payments, discounted by the risk-free rate and the survival probability:

$$PV_{\text{prem}} = \mathbb{E}\left[\int_0^T \mathrm{DF}(t)\, U_{\text{par}}\, \mathbb{1}[T_1 > t]\right] = U_{\text{par}} \int_0^T \mathrm{DF}(t) S(t) dt. \tag{A.2}$$

The PV of the protection leg is given by the present value of the random payment of the notional loss given default, denoted with LGD, at default time T_1, if such time is before expiry T, and zero otherwise:

$$PV_{\text{prot}} = \mathbb{E}\left\{DF(T_1) \times LGD \times \mathbb{1}[T_1 \leq T]\right\} = \mathrm{LGD} \int_0^T \mathrm{DF}(t) S(t) \lambda(t) dt. \tag{A.3}$$

Equating the two legs we obtain the par spread as

$$U_{\text{par}} = \frac{\mathrm{LGD}\ \int_0^T \mathrm{DF}(t)\ S(t)\lambda(t)dt}{\int_0^T \mathrm{DF}(t) S(t) dt}. \tag{A.4}$$

Assuming that the hazard rate is constant ($\lambda(t) = \lambda$) simplifies the expression to

$$\lambda = \frac{U_{\text{par}}}{\mathrm{LGD}}. \tag{A.5}$$

The probability of default in $(0, T)$ is thus given by

$$\mathrm{DP}_T = 1 - S(T) = 1 - e^{-\lambda T} = 1 - \exp\left\{-\frac{U_{\text{par}}}{\mathrm{LGD}} T\right\} \tag{A.6}$$

and the annual probability is obtained by setting $T = 1$.

A.2 More long-run facts.

Figure A.1 replicates Figure 2 replacing CPI inflation with realised exchange rate depreciation on the y-axis.

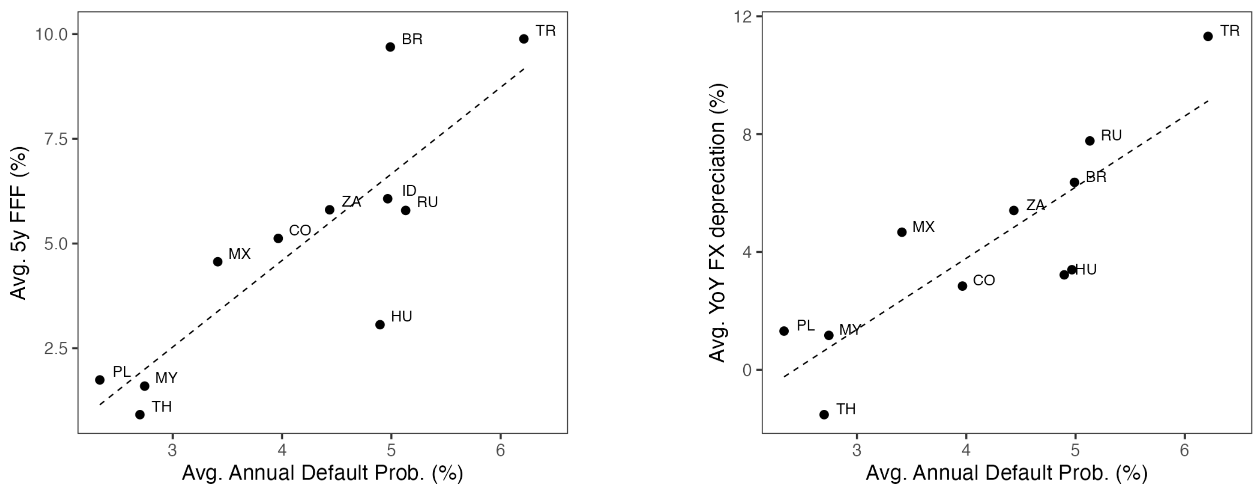

Figure A.1: Long-term averages over the sample period. The left panel plots default probabilities against FFF rates. The right panel plots default probabilities against year-on-year nominal exchange rate depreciation.

A.3 Dynamic Factor Model and Fixed Effects Regressions

Table A.1 reports the results for different specifications: columns (1) to (4) include different combinations of controls and fixed effects; columns (5) to (8) report panel regression results on the residuals from the dynamic factor model estimation.

Table A.1: Regression results.

	FFF (1)	FFF (2)	FFF (3)	FFF (4)	FFF (res) (5)	FFF (res) (6)	FFF (res) (7)	FFF (res) (8)
DP	0.707***	0.700***	0.507***	0.519***				
	(0.087)	(0.081)	(0.062)	(0.068)				
DP (res)					0.681***	0.669***	0.651***	0.650***
					(0.149)	(0.134)	(0.160)	(0.160)
Debt/GDP		-2.860*		-1.052***		-3.588*		-0.312*
		(1.539)		(0.216)		(1.896)		(0.175)
GDP cycle		0.106		8.779		5.360		3.610
		(7.375)		(6.526)		(6.119)		(3.793)
Num.Obs.	602	602	602	602	517	517	517	517
R2	0.632	0.637	0.472	0.487	0.404	0.427	0.306	0.311
FE: country	✓	✓			✓	✓		
FE: date	✓	✓			✓	✓		

Notes: Standard errors clustered by country. Stars indicate significance at the * 10%, ** 5%, and *** 1% levels.

B Derivations

B.1 Inflation Cost Specification

Consider the baseline model of Section 5.1, replacing the utility cost of inflation with a resource cost à la Rotemberg (1982), proportional to output and given by

$$\Theta(y) := \frac{\theta}{2}\pi^2 y$$

The planner's problem when in repayment and assuming unconstrained lump-sum taxation (i.e. $u_c = u_g$) is given by

$$\begin{aligned} V^R(b, y) = \max_{c,g,\pi,b'} \quad & \Big\{ u(c, g) + \beta \mathbb{E}[V(b', y') \,|\, y] \Big\} \\ \text{s.t.} \quad & \frac{b}{1+\pi} + g + c = \tau y - \frac{\theta}{2}\pi^2 y + q(b', y)b'. \end{aligned}$$

The optimality condition for inflation is given by

$$\frac{b}{(1+\pi)^2} = \theta y \pi. \tag{B.7}$$

Let us compare this to the main text. Assuming $v(\pi) = \alpha_\pi \frac{\pi^2}{2} y^\xi$, condition (14) would become

$$c^{-\gamma}\frac{b}{(1+\pi)^2} = \alpha_\pi \pi y^\xi, \tag{B.8}$$

so that conditions (B.7) and (B.8) are equivalent if $\theta = \alpha_\pi c^\gamma y^{\xi-1}$. In the baseline model, $\rho(c, y) = 0.86$, so if we assume that $c \approx y$ the equivalence conditions become $\theta = \alpha_\pi$ and $\xi = -1$.

B.2 Sequential Formulation of V_b

I describe the steps that lead to the derivation of equation (17). Since the shocks are either Markov (in the case of output) or i.i.d. (in the case of the re-entry option), the probability of history s_{t+1}^{t+k} conditional on history s^t is given by $P(s_{t+1}^{t+k} \,|\, s^t) = P(s_{t+1} \,|\, s_t) \times P(s_{t+2} \,|\, s_{t+1}) \times \cdots \times$

$P(s_{t+k} \mid s_{t+k-1})$. To gain intuition, let us expand equation (16) up to period $t+3$

$$\mathbb{E}_t[V_b(b_{t+1}, y_{t+1})] = \beta \sum_{s_{t+1}} P(s_{t+1}|s_t) \frac{[1-\delta(s_{t+1})]}{1+\pi(s_{t+1})} u_g(s_{t+1}) \tag{B.9}$$

$$+ \beta^2 \sum_{s^2} P(s^{t+2}|s_t) \frac{\delta(s_{t+1})}{1+\pi(s_{t+1})} \frac{\theta(1-h)[1-\delta_{t+2}(s_{t+2})]}{1+\pi(s_{t+2})} u_g(s_{t+2}) \tag{B.10}$$

$$+ \beta^3 \sum_{s^{t+3}} P(s^{t+3}|s_t) \frac{\delta(s_{t+1})}{1+\pi(s_{t+1})} \frac{\theta(1-h)\delta(s_{t+2})}{1+\pi(s_{t+2})} \frac{\theta(1-h)[1-\delta(s_{t+3})]}{1+\pi(s_{t+3})} u_g(s_{t+3}) \tag{B.11}$$

$$+ \sum_{s^{t+3}} P(s^{t+3}|s_t) \frac{\delta(s_{t+1})}{1+\pi(s_{t+1})} \frac{(1-\theta)}{1+\pi(s_{t+2})} \frac{\theta(1-h)[1-\delta(s_{t+3})]}{1+\pi(s_{t+3})} u_g(s_{t+3}) \tag{B.12}$$

$$+ \dots \tag{B.13}$$

In words:

- line (B.9) represents the set of histories where the government repays at $t+1$;
- line (B.10) represents the set of histories where the government defaults at $t+1$, and repays given the option to re-enter at $t+2$;
- line (B.11) represents the set of histories where the government defaults at $t+1$, stays in default given the option to re-enter at $t+2$, repays given the option to re-enter at $t+3$;
- line (B.12) represents the set of histories where the government defaults at $t+1$, has no option to re-enter at $t+2$, repays given the option to re-enter at $t+3$.

That is, to compute the expected discounted real value of debt at the end of a given history, we must keep track of all re-entry options available (and thus haircuts applied to debt in default) as well as all state-contingent inflation rates. Function $\chi(s)$ does exactly that for a given history s.

C Numerical Solution Method

The government recursive problem after the addition of taste shocks is as follows. All the shocks introduced below $(\epsilon_R, \epsilon_D, \epsilon_{b'}, \epsilon_\pi)$ are assumed to be identically and independently distributed according to a Gumbel distribution with a mean equal to minus the Euler-Mascheroni constant, and a standard deviation of one.

The value of the option to default is

$$V(b,y;\{\epsilon_R,\epsilon_D\}) = \max_{\delta\in\{0,1\}} \Big\{(1-\delta)\Big[V^R(b,y)+\rho_\delta\,\epsilon_R\Big] + \delta\Big[V^D(b,y)+\rho_\delta\,\epsilon_D\Big]\Big\}.$$

The sovereign value function upon repayment is

$$V^R(b,y;\{\epsilon_{b'}\}) = \max_{b'}\left\{W^R(b,y;b')+\rho_{b'}\,\epsilon_{b'}\right\}$$

where

$$W^R(b,y;b') = \max_{c,g,\pi,\tau}\ \Big\{u(c,g)-v(\pi)+\beta\mathbb{E}\left[V(b',y')\mid y\right]\Big\} \tag{C.14}$$

$$\text{s.t.}\quad \frac{b}{1+\pi}+g = \tau y + q(b',y)b' + s(\pi) \tag{C.15}$$

$$c+g = y-\frac{b}{1+\pi}+q(b',y)b' \tag{C.16}$$

$$\tau \le \overline{\tau} \tag{C.17}$$

and each b' choice is associated with an element of the taste shock vector $\{\epsilon_{b'}\}$.

The value function of the government upon default is

$$V^D(b,y;\{\epsilon_\pi\}) = \max_{\pi}\left\{W^D(b,y;\pi)+\rho_\pi\,\epsilon_\pi\right\}$$

where

$$\begin{aligned} W^D(b,y;\pi) = &\max_{c,g,\tau}\ \left\{u(c,g)-v(\pi)+\beta\,\mathbb{E}\left[\theta\,V\left(\frac{b(1-h)}{1+\pi},y'\right)+(1-\theta)\,V^D\left(\frac{b}{1+\pi},y'\right)\right]\right\} \\ \text{s.t.}\quad & \tau y + s(\pi) = g \\ & c+g = y^D(y) \\ & \tau\le\overline{\tau} \end{aligned}$$

and each π choice is associated with an element of the taste shock vector $\{\epsilon_\pi\}$.

The above assumptions imply that, for each value function-choice pair

$$(W,x)\in\{(V,\delta),(V^R,b'),(V^D,\pi)\},$$

the probability that choice x is optimal is given by

$$\mathrm{P}(x\,|\,b,y) = \frac{\exp\{W(b,y;x)/\rho_x\}}{\sum_x \exp\{W(b,y;x)/\rho_x\}},$$

and the expected value of the value functions evaluated at the optimal choice (i.e., of the maximum) can be written as

$$W(b,y) = \rho_x \log\left(\sum_x \exp\{W(b,y;x)/\rho_x\}\right).$$

In the calibration of the model, I choose values of $(\rho_{b'}, \rho_\pi, \rho_\delta)$ such that the policy functions are smooth, the model does not have convergence issues, and the economic magnitude of the taste shocks is small.

To measure this magnitude, I compute the expected percentage utility loss from choosing a policy that is different from the best choice absent taste shocks, that is

$$\sum_x \mathrm{P}(x \,|\, b,y) \log\left(\frac{W(b,y;x)}{\max_{x'} W(b,y;x')}\right),$$

and take the average of this quantity over the (b,y) state space. I choose $(\rho_\delta, \rho_{b'}, \rho_\pi)$ equal to $(5, 8.5, 80) \times 10^{-4}$ for the baseline model and to $(4.25, 8.5, 75) \times 10^{-4}$ for the constrained model. The parameter values are such that the average expected utility loss for each value function is equal to 0.1%.