Sovereign Debt Standstills*

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November 1, 2025

Abstract

As a response to the economic difficulties triggered by the COVID-19 pandemic, the G20 implemented the Debt Service Suspension Initiative (DSSI), a standstill or suspension of official bilateral sovereign debt payments for some of the poorest countries. The G20 and others also called on private creditors to offer comparable terms but this did not materialize. We first show that a standard default model can account for the decline in sovereign spreads triggered by the DSSI. The model also accounts for the private creditors' reluctance to participate in a debt standstill: A private-creditor standstill implies sizable capital losses for debt holders. Furthermore, while sovereign debt standstill proposals emphasize debt payment suspensions without write-offs on the face value of debt obligations, we find that complementing private-creditor standstills with write-offs could reduce debt holders' losses and simultaneously increase sovereign welfare gains.

JEL classification: F34, F41.

Keywords: DSSI, Debt relief, Standstill, Haircuts, debt write-offs, COVID-19, Default, Debt Overhang, Voluntary Debt Exchange.

*For their comments and suggestions we thank the editor, Cristina Arellano, an anonymous referee, Tamon Asonuma, Javier Bianchi, Hal Cole, Max Dvorkin, Rob Johnson, Illenin Kondo, David Mihalyi, Zach Stangebye, and seminar participants at the 2023 Stockman Conference, Notre Dame, IMF, Minneapolis Fed, University of Oklahoma, RedNIE, Virtual International Trade and Macroeconomics Seminar, the "Emerging and Frontier Markets: Capital Flows, Resiliency, Risks, and Growth" NBER Conference, the 2022 SED Annual Meeting, the 2021 CEBRA Annual Meeting, the 2021 Banco Central de Uruguay Annual Meeting, and the 2020 Richmond Fed Sovereign Debt Workshop. Remaining mistakes are our own. The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

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1 Introduction

As a response to COVID-19, the Group of 20 leading economies (G20) established the Debt Service Suspension Initiative (DSSI), which implemented a standstill or suspension of official bilateral sovereign debt payments for some of the poorest countries.[1] The G20 and others (Bolton et al., 2020; Gelpern et al., 2020) also called on private creditors to offer comparable terms and to include other low and middle-income countries in the initiative, but this did not materialize. It is also often emphasized that standstills should not be accompanied by write-offs (reductions in the face value of debt obligations) to avoid the perception of creditors' losses.[2] This paper presents a quantitative evaluation of standstills that provide debt relief after the sovereign suffers a large shock.

We study a standard sovereign default model à la Eaton and Gersovitz (1981) augmented with official debt. Following Aguiar and Gopinath (2006) and Arellano (2008), the default model is commonly used for quantitative studies of sovereign debt crises.[3] A small open economy receives a stochastic endowment stream of a single tradable good. At the beginning of each period, when the government is not in default, it decides whether to default on its debt. A defaulting government faces an income cost and is temporarily prevented from borrowing. When the government is not in default, before the period ends, the government may change its debt positions. We calibrate the model targeting data from Pakistan, the first country that participated in the DSSI.

We first show that the standard default model can account for the decline in sovereign spreads triggered by the DSSI. We focus on initial states with economic distress in which

[1]The initiative made eligible countries that could receive resources from the World Bank's International Development Association, and countries classified as least-developed by the United Nations. Countries in arrears to the World Bank or to the IMF were excluded. Forty-eight out of 73 eligible countries participated in the DSSI. Lang et al. (2023) find that participation was driven by both economic needs and expected benefits: Lower GDP per capita and higher levels of public debt service were associated with a higher likelihood of participation.

[2]Even before COVID-19, there were widespread proposals for sovereign debt payment suspensions without write-offs. For example, it was proposed to require standstills (or the "reprofiling" of debt payments without write-offs) before the implementation of IMF programs and to include standstills triggered by liquidity shocks in sovereign bond covenants (Barkbu et al., 2012; Brooke et al., 2011; Buiter and Sibert, 1999; Consiglio and Zenios, 2015; IMF, 2017a; IMF, 2017b; Weber et al., 2011). Sovereign debt restructurings have also favored the postponement of payments over write-offs (Dvorkin et al., 2021).

[3]This model is also used in studies of household default (Athreya et al., 2007; Chatterjee et al., 2007; Hatchondo et al., 2015; Li and Sarte, 2006; Livshits et al., 2008).

the cost of accessing debt markets is high. To that end, we consider an income shock that increases the spread by 303 basis points, on average. The sovereign spread increased 302 basis points in Pakistan in the second quarter of 2020. We then impose a two-year official-debt standstill calibrated to give the government additional resources equivalent to 0.4% of average annual aggregate income, comparable to the resources freed for Pakistan with the DSSI. We find that this standstill lowers the sovereign spread by 56 basis points on average, which is within the range of spread reductions after the implementation of the DSSI (Lang et al., 2023).

We next evaluate the effects of a standstill with private creditors. We find that in contrast with the DSSI (i.e., a standstill with official creditors), a standstill with private creditors increases the sovereign spread significantly: For the same shock that increases the spread by 303 basis points (without a standstill), the spread increases by 970 basis points on average if the standstill of two years is for private-creditor debt. Furthermore, this spread increase is persistent, with spreads remaining above those in the no-standstill scenario for several years. Debt levels increase during the standstill and, therefore, even though the default probability is lower during the standstill, the default probability increases substantially when the standstill is over and the government has to resume making debt payments.[4]

Since standstills with private creditors increase the spread, they generate capital losses for these creditors, i.e., a decline in the market value of their debt holdings. Creditors are not properly compensated for the increase in the default probability at the end of the standstill. Creditors' losses are significant because after large negative shocks, the debt price becomes more sensitive to changes in the debt level. For example, for the same income shock used for the exercises described above and the average debt portfolio in the simulations, a two-year private-creditor standstill produces capital losses of 31%. This is consistent with the private creditors' reluctance to participate in standstills, and indicates that this reluctance does not only depend on the free-riding or holdout problem often emphasized in policy discussions (Wright, 2011). Of course, standstills produce welfare gains for the sovereign. These welfare gains can be significant. For instance, the two-year private-creditor standstill described

[4]Arellano et al. (2023) document that countries typically exit restructurings with higher debt levels, as the sovereign exits standstills in our simulations.

above produces welfare gains equivalent to a 0.8% permanent consumption increase.

We also show that, in contrast with the policymakers' aversion to debt write-offs, combining private-creditor standstills with write-offs produces a Pareto improvement for the sovereign and creditors (as a group). This is, combining standstills with write-offs can simultaneously reduce the capital losses triggered by the standstill and increase the sovereign's welfare gains. For the example presented above, adding to the two-year private-creditor standstill a debt write-off of 30% on the face value of the debt eliminates 16% of the private creditors' capital losses, while more than doubling the sovereign's welfare gains. Both larger shocks and higher debt levels due to a private-creditor standstill generate situations of debt overhang and thus increase Pareto gains from write-offs.[5]

While write-offs achieve debt relief through a persistent decline in debt payments, standstills achieve debt relief only through a temporary reduction in debt payments and an increase in debt payments when the standstill is over. Thus, standstills tend to increase the default probability and generate losses for creditors. In contrast, write-offs lower indebtedness and the default probability, and can create gains for creditors. Overall, our results cast doubts on the emphasis on avoiding write-offs for private-creditor standstills, and even more so after large shocks such as COVID-19.

1.1 Related literature

Lang et al. (2023) use the relatively unexpected nature of the DSSI to measure the effect of payment suspensions on the sovereign spread using synthetic controls. For 18 DSSI-eligible countries, they compute the combination of 52 non-eligible countries that best replicate the pre-DSSI paths of a set of aggregate variables (GDP growth, debt ratio, fiscal balance, current account balance, foreign reserves, and the sovereign spread). Then, they compare the observed spread path of the 18 eligible countries with the counterfactual post-DSSI spread

[5]The possibility of Pareto improvements from write-offs in a situation of debt overhang due to the negative effect of debt on investment has long been recognized (Froot, 1989; Krugman, 1988a; Krugman, 1988b; Sachs, 1989). In this paper, there is a form of debt overhang even without investment, because a debt reduction (write-off) lowers default risk and thus increases the market value of debt claims. Note that while introducing write-offs would benefit creditors as a group (and thus, creditors as a group would accept voluntarily these write-offs), this does not mean that individual creditors would accept these write-offs. This is because of the well-known free-riding or holdout problem (Wright, 2011).

of the corresponding synthetic countries. They find that the post-DSSI spread is lower for eligible countries, with a median spread gap of around 150 basis points in the weeks following the DSSI announcement.

Arellano et al. (2024) present a rich model of the COVID-19 pandemic and its effect on sovereign default risk. They study the effects of debt relief in the form of new non-defaultable loans. We focus on the simpler standard default model and study standstills and write-offs.

Hatchondo et al. (2020b), Mallucci (2022), and Phan and Schwartzman (2021) study sovereign default models with bonds that incorporate debt relief after a negative shock. This debt relief affects bond prices at the time bonds are issued. In contrast, motivated by the pandemic, we study one-time unanticipated debt relief policies triggered by extraordinary circumstances.

Since standstills are a form of debt maturity extension and debt relief can be thought of as debt restructuring, our results are related to those in studies of optimal maturity choices and debt restructurings. Aguiar et al. (2019) present a model in which it is optimal to shorten debt maturity in debt restructurings. This is the case because of a time-inconsistency problem that arises in default models with long-term debt (Arellano and Ramanarayanan, 2012; Chatterjee and Eyigungor, 2012, 2015; Hatchondo and Martinez, 2009; Hatchondo et al., 2020a, 2016; Sanchez et al., 2018): The government would like to commit to lower indebtedness and thus higher bond prices in the future because (with long-term debt) this would imply it can sell bonds at a higher price today. This problem is worse with longer-maturity debt. Therefore, (at the moment of the restructuring) it is optimal to choose shorter maturities.

Dvorkin et al. (2021) and Mihalache (2020) show that in spite of the government's time inconsistency problem, it is possible to account for the extensions of maturity in the restructurings data with a richer model in which: (i) There is risk of loosing access to debt markets, (ii) there is a regulatory cost of write-offs, and (iii) restructurings occur after the economy recovers from the shock that triggered the default. Our analysis differs from theirs in several dimensions: Difficulties in market access in our exercises are given by the endogenous borrowing constraint, we do not consider a regulatory cost of write-offs, and we focus on preventive debt relief at the moment the economy is hit by an adverse shock. Furthermore, Aguiar et al. (2019), Dvorkin et al. (2021), and Mihalache (2020) model the bargaining between creditors and the government and focus on restructurings that do not generate capital losses for creditors. We evaluate standstill proposals that could generate losses for creditors and study how the outcomes of these proposals could be improved with write-offs.[6]

We show that debt write-offs tend to be superior to debt standstills, which is consistent with the findings of Aguiar et al. (2019), Dvorkin et al. (2021), and Mihalache (2020). However, the mechanism behind our findings is different from the overindebtedness due to time inconsistency they highlight. We show that during the standstill, debt issuances are not significant (and are lower than what they would have been without the standstill), but debt still increases because it is automatically rolled over.[7] This distinction is important, because while limiting borrowing through conditionality or fiscal rules (Hatchondo et al., 2022) mitigates the time inconsistency problem emphasized by Aguiar et al. (2019), Dvorkin et al. (2021), and Mihalache (2020), it would not mitigate the shortcomings of standstills (without significant debt issuances).

Instead of the time inconsistency problem underscored in previous studies, we emphasize that standstills and write-offs move indebtedness in the opposite direction. Furthermore, while our results on the advantages of write-offs over standstills are consistent with the findings against maturity extensions, we show that for large-enough write-offs, losses from adding standstills to the write-off are not significant.

Finally, our paper is related to the literature on the interaction between official and private sovereign debt. Recent works in this area include Arellano and Barreto (2025), Liu et al. (2025), Roldán and Sosa-Padilla (2025), and Kondo et al. (2025). We differ from these studies in our focus on the quantitative implications of debt relief through standstills and write-offs.

The rest of the article proceeds as follows. Section 2 introduces the model. Section 3 presents the results. Section 4 concludes.

[6] Analyzing how losses could be imposed to private creditors (for instance, through the doctrine of necessity or financial repression) is beyond the scope of this paper.

[7] Since the relief implied by the standstill is short-lived and market access conditions are not expected to be favorable when the government needs to start rolling over debt after the standstill (in part because of higher debt levels due to the standstill), the government does not want to issue much debt during the standstill.

2 The model

We present a standard default model augmented with official loans.

2.1 Environment

The government has preferences given by

$$\mathbb{E}_t \sum_{j=t}^{\infty} \beta^{j-t} u\left(c_j\right),$$

where $\mathbb{E}$ denotes the expectation operator, β denotes the subjective discount factor, and c_t represents consumption of private agents. The utility function is strictly increasing and concave. The government cannot commit to future (default and borrowing) decisions.

The timing of events within each period is as follows. First, the government learns the economy's income. After that, the government chooses whether to default on its debt. Before the period ends, the government may change its debt positions, subject to the constraints imposed by its default decision.

The economy's endowment of the single tradable good is denoted by $y \in Y \subset \mathbb{R}_{++}$. This endowment follows a Markov process.

We assume that the government issues long-term debt to both private creditors and official lenders. As in Arellano and Ramanarayanan (2012) and Hatchondo and Martinez (2009), long-term debt instruments are perpetuities with coupon payments that decay at a constant rate. Debt dynamics can be represented as follows:

$$b' = (1 - \delta^b)b + \iota^b,$$
$$\ell' = (1 - \delta^\ell)\ell + \iota^\ell,$$

where b and ℓ (b' and ℓ') denote the number of private-creditor debt and official loan coupons due at the beginning of the current (next) period, ι^b and ι^ℓ denote the number of private-creditor bonds and official loans contracted in the current period, and private-creditor debt and official loan coupons decline at the rates δ^b and δ^ℓ, respectively. Modeling long-term debt is essential to capture the effects on the sovereign spread of expected changes in debt levels because of the standstill.

Following Dvorkin et al. (2021), we assume adjustment cost for changing the debt portfolio:

$$\text{Portfolio adjustment cost} = \tau \left(|b' - b| + |\ell' - \ell| \right).$$

This prevents large changes in the composition of the debt portfolio.

Motivated by several studies that document that the risk premium is an important component of sovereign spreads (Borri and Verdelhan, 2009; Longstaff et al., 2011), we assume that bonds are priced in a competitive market inhabited by a large number of risk-averse private creditors: The price of bonds satisfies a no-arbitrage condition with a stochastic discount factor

$$M(y_{t+1}, y_t) = \exp(-r - \alpha\varepsilon_{t+1} - 0.5\alpha^2\sigma_\varepsilon^2),$$

where r denotes the risk-free rate at which lenders can borrow or lend, and $\varepsilon_{t+1} = \log(y_{t+1}) - \mathbb{E}_t(\log(y_{t+1}))$ denotes the innovation to the economy's endowment in period $t+1$. This formulation is a special case of the discrete-time version of the Vasicek one-factor model of the term structure (Backus et al., 1998; Vasicek, 1977) and allows us to introduce risk premium in a tractable way. The parameter α can be interpreted as a combination of lenders' risk aversion and their exposure to default risk.

The government can request official loans up to an exogenous limit $\bar{\ell}$. We assume official loans offer more favorable terms than private-creditor debt, as they are priced by zero-profit risk-neutral lenders that discounts future payments at the risk-free rate r.

For simplicity, we assume that when the government defaults, it does so on all current and future marketable and official debt obligations.[8] After defaulting, the government cannot borrow for a stochastic number of periods. Income is given by $y - \phi(y)$ in every period in which the government cannot borrow. Starting the first period after the default period, with a constant probability $\psi \in [0, 1]$, the government may regain access to borrowing, and creditors recover a fraction of their original debt claims. We denote the recovery rate of

[8] Arellano and Barreto (2025) allow for selective defaults, but this seems inconsequential for the exercise in this paper. We find equivalent results when we assume that official debt is not defaultable.

official loans by θ^ℓ, and the recovery rate of marketable bonds by θ^b. Defaulted claims grow at the risk-free rate r until the government regains access to borrowing.

The recovery rate of official loans is determined as follows:

$$\theta^\ell(\ell) = \min\left\{\frac{\ell^e}{\ell}, 1\right\}, \tag{1}$$

where ℓ^e denotes the maximum post-exchange official loan level. The recovery rate of marketable bonds is determined as follows:

$$\theta^b(b,\ell) = \begin{cases} \min\left\{\frac{b^e+\ell^e-\ell}{b}, 1\right\} & \text{if } \ell < \ell^e \\ \min\left\{\frac{b^e}{b}, 1\right\} & \text{otherwise.} \end{cases} \tag{2}$$

Private creditors receive at most b^e bonds as long as the amount of loans is sufficiently low. Note that we need to make the recovery rate of marketable bonds a function of official loans to mitigate incentives to reduce official loans below l^e before the restructuring, by issuing more marketable bonds, while still exiting the restructuring with b^e.[9] The parameters $\{b^e, \ell^e\}$ are used to calibrate the recovery rates.

We assume that the government cannot issue marketable bonds at a price lower than $\underline{q}$. In a model with long-term debt and positive recovery rates, before defaulting, the government may finance a large increase in consumption by issuing large amounts of bonds (Hatchondo et al., 2014). To avoid this, we choose a value of $\underline{q}$ that eliminates consumption booms before defaults.

2.2 Recursive formulation

Let d denote the current-period default decision. We assume that d is equal to 1 if the government defaults and is equal to 0 if it does not. Let V denote the government's value function at the beginning of a period, that is, before the default decision is made. Let V_0 denote the value function of a sovereign not in default. Let V_1 denote the value function of a sovereign in default. Let F denote the conditional cumulative distribution function of the next-period endowment y'. The function V satisfies the following functional equation:

[9] In the simulations, market debt b is higher than b^e. That is why we do not need to assume that the recovery rate of official loans depends on the level of marketable debt.

$$V\left(b,\ell,y\right)=\max_{d\epsilon\{0,1\}}\{dV_{1}(b,\ell,y)+(1-d)V_{0}(b,\ell,y)\},\tag{3}$$

where

$$V_{1}(b,\ell,y)=u\left(y-\phi\left(y\right)\right)+\beta\int\left[\psi V(\theta^{b}b',\theta^{\ell}\ell',y')+\left(1-\psi\right)V_{1}(b',\ell',y')\right]F\left(dy'\mid y\right),\tag{4}$$
$$s.t.\quad b'=e^{r}b,\ \text{and}\ \ell'=e^{r}\ell$$

denotes the value of defaulting. With probability ψ, the government exits default in the next period by exchanging the portfolio of debt in default (b',ℓ') for $\left(\theta^{b}(b',\ell')b',\theta^{\ell}(\ell')\ell'\right)$, as defined in equations (1)-(2).

The value of repayment satisfies

$$V_{0}(b,\ell,y)=\max_{b'\geq0,\ell'\in[0,\bar{\ell}]}\left\{u\left(c\right)+\beta\int V(b',\ell',y')F\left(dy'\mid y\right)\right\}.\tag{5}$$
$$s.t.\quad c=y-b-\ell+q^{b}(b',\ell',y)\left[b'-(1-\delta^{b})b\right]+q^{\ell}(b',\ell',y)\left[\ell'-(1-\delta^{\ell})\ell\right]-\tau\left(|b'-b|+|\ell'-\ell|\right)$$
$$q^{b}(b',\ell',y)\geq\underline{q}\ \forall\ b'>b(1-\delta^{b}),$$

The bond price is given by the following functional equation:

$$\begin{aligned}q^{b}(b',\ell',y)=&\int M(y',y)\left[1-\hat{d}\left(b',\ell',y'\right)\right]\left[1+(1-\delta^{b})q^{b}(\hat{b}(b',\ell',y'),\hat{\ell}(b',\ell',y'),y')\right]F\left(dy'\mid y\right)\\&+\int M(y',y)\ \hat{d}\left(b',\ell',y'\right)\ q_{D}^{b}(b',\ell',y')\ F\left(dy'\mid y\right),\end{aligned}\tag{6}$$

where $\hat{d}$, $\hat{b}$, and $\hat{\ell}$ denote the future default and borrowing rules that lenders expect the government to follow. The default rule $\hat{d}$ is equal to 1 if the government defaults and is equal to 0 otherwise. The function q_{D}^{b} denotes the price of a defaulted bond, which is determined by

$$
\begin{aligned}
q_D^b(b,\ell,y) =& \psi\theta^b\left(e^r b, e^r \ell\right) e^r \int M(y',y)\left[(1-d')\left[1+(1-\delta^b)q^{b'}\right]+d' {q_D^b}'\right] F\left(dy' \mid y\right) \\
& + (1-\psi)e^r \int M(y',y)\, q_D^b(e^r b, e^r \ell, y')\, F\left(dy' \mid y\right), \qquad (7) \\
& d' = \hat{d}\left(\theta^b(e^r b, e^r \ell)e^r b, \theta^\ell(e^r \ell)e^r \ell, y'\right), \\
& q^{b'} = q^b\left(\hat{b}\left(\theta^b(e^r b, e^r \ell)e^r b, \theta^\ell(e^r \ell)e^r \ell, y'\right), \hat{\ell}\left(\theta^b(e^r b, e^r \ell)e^r b, \theta^\ell(e^r \ell)e^r \ell, y'\right), y'\right), \\
& {q_D^b}' = q_D^b\left(\theta^b(e^r b, e^r \ell)e^r b, \theta^\ell(e^r \ell)e^r \ell, y'\right).
\end{aligned}
$$

The first line of equation (7) captures the expected value of a bond after the government conducts a debt exchange to exit default. The government arrives at the exchange with a portfolio of $(e^r b, e^r \ell)$ bonds and loans and exits the exchange with a portfolio of $\left(\theta^b(e^r b, e^r \ell)e^r b, \theta^\ell(e^r \ell)e^r \ell\right)$ bonds and loans. The government has to resume coupon payments immediately after the exchange. If the government pays its coupon obligations, the exchanged bonds trade at the price $q^{b'}$. If the government defaults after the exchange, the exchanged bonds trade at the price $q_D^{b'}$. The second line of equation (7) captures the expected value of a bond that remains in default.

Likewise, the price of a loan satisfies

$$
\begin{aligned}
q^\ell(b',\ell',y) =& \int e^{-r}\left[1-\hat{d}\left(b',\ell',y'\right)\right]\left[1+(1-\delta^\ell)q^\ell(\hat{b}(b',\ell',y'),\hat{\ell}(b',\ell',y'),y')\right] F\left(dy' \mid y\right) \\
& + \int e^{-r}\, \hat{d}\left(b',\ell',y'\right)\, q_D^\ell(b',\ell',y')\, F\left(dy' \mid y\right). \qquad (8)
\end{aligned}
$$

The difference between the price of a bond (equation 6) and the price of a loan (equation 8) is that in the latter, expected loan payments are discounted at the risk-free rate (while the price of a bond is affected by the risk premium). The function q_D^ℓ denotes the value of a loan in default, which is determined by

$$
\begin{aligned}
q_D^\ell(b,\ell,y) =& \psi\theta^\ell\left(e^r\ell\right)e^r\int e^{-r}\left[(1-d')\left[1+(1-\delta^\ell)q^{\ell'}\right]+d'q_D^{\ell'}\right]F\left(dy'\mid y\right)\\
&+(1-\psi)e^r\int e^{-r}\,q_D^\ell(e^rb,e^r\ell,y')\,F\left(dy'\mid y\right), \qquad (9)\\
&d'=\hat{d}\left(\theta^b(e^rb,e^r\ell)e^rb,\theta^\ell(e^r\ell)e^r\ell,y'\right),\\
&q^{\ell'}=q^\ell\left(\hat{b}\left(\theta^b(e^rb,e^r\ell)e^rb,\theta^\ell(e^r\ell)e^r\ell,y'\right),\hat{\ell}\left(\theta^b(e^rb,e^r\ell)e^rb,\theta^\ell(e^r\ell)e^r\ell,y'\right),y'\right),\\
&q_D^{\ell'}=q_D^\ell\left(\theta^b(e^rb,e^r\ell)e^rb,\theta^\ell(e^r\ell)e^r\ell,y'\right).
\end{aligned}
$$

2.3 Equilibrium definition

A Markov Perfect Equilibrium is characterized by:

1. A default rule $\hat{d}$ and borrowing rules $\hat{b}$ and $\hat{\ell}$,
2. Bond price functions $\left\{q^b, q_D^b\right\}$,
3. Loan price functions $\left\{q^\ell, q_D^\ell\right\}$,

such that:

(a) Given $\hat{d}$, $\hat{b}$,and $\hat{\ell}$, the bond and loan price functions are given by equation (6)-(9); and

(b) the default rule $\hat{d}$ and borrowing rules $\hat{b}$ and $\hat{\ell}$ solve the dynamic programming problem defined by equations (3)-(5), when the price of bonds and loans is given by the functions $\{q^b, q^\ell\}$.

2.4 Calibration

We follow a standard calibration strategy, using as reference data from Pakistan, the first country that participated in the DSSI. The utility function displays a constant coefficient of relative risk aversion, i.e.,

$$u\left(c\right)=\frac{c^{1-\gamma}-1}{1-\gamma},\ \text{with } \gamma\neq 1.$$

Table 1: Benchmark parameter values.

Risk aversion	γ	2	Standard
Risk-free rate	r	1%	Standard
Probability default ends	ψ	0.083	$\mathbb{E}$(exclusion) = 3 years
Bond duration	δ^b	0.0415	Debt duration = 5 years
Official loan duration	δ^ℓ	0.0201	Loan duration = 8.4 years
Maximum official debt	$\bar{\ell}$	0.36	Bilateral debt / total debt = 15%
Market debt after exiting a default	b^e	1.394	Recovery rate = 64%
Official loans after exiting a default	ℓ^e	0.178	Recovery rate = 45%
Pricing kernel	α	25	Sharpe ratio = 0.5
Minimum bond price	$\underline{q}$	0.6 / $(\mathrm{e}^r - 1 + \delta^b)$	Maximum spread = 13.4%
Portfolio adjustment cost	τ	0.01	No pre-default buybacks
Income autocorrelation coefficient	ρ	0.92	Pakistan GDP
Standard deviation of innovations	σ_ϵ	1.125%	Pakistan GDP
Mean log income	μ	(-1/2)σ_ϵ^2	Pakistan GDP
Calibrated to match targets			
Income cost of defaulting	λ_0	0.122	Average debt 59 %
Income cost of defaulting	λ_1	1.138	Average spread =5.9%
Discount factor	β	0.95	Average spread =5.9%

Note: We choose the maximum value for the discount factor β that can enable the model to match the spread and debt levels.

The endowment process follows:

$$\log(y_t) = (1-\rho)\,\mu + \rho\log(y_{t-1}) + \varepsilon_t,$$

with $|\rho| < 1$, and $\varepsilon_t \sim N(0, \sigma_\epsilon^2)$. As in Chatterjee and Eyigungor (2012), we assume a quadratic loss function for income during a default episode:

$$\phi(y) = \max\left\{y\left[\lambda_0 + \lambda_1[y - \mathbb{E}(y)]\right], 0\right\}.$$

Table 1 presents the benchmark values given to all parameters in the model. A period in the model refers to a quarter. The coefficient of relative risk aversion and the risk-free interest rate take standard values. Following Dias and Richmond (2009), we assume an average duration of sovereign default events of three years ($\psi = 0.083$).

We set $\delta^b = 4.15\%$. With this value and our target for the average spread, bonds have an average duration (discounted at the risk-free rate) of 5 years in the simulations, consistent with the average debt maturity for Pakistan (Ministry of Finance). Arellano and Barreto (2025) document that the average duration for official loans is higher than the average duration of private-creditor debt. We target an average duration of official loans of 8.4 years and set $\delta^\ell = 2.01\%$.[10] We set $\bar{\ell} = 0.36$. With the average level of marketable debt targeted in the simulations, this gives us a ratio of official debt (eligible for the DSSI) over total debt of 15 percent, consistent with the ratio in Pakistan (Ministry of Finance). We choose the number of marketable bonds and official loans after the sovereign exits default to match the recovery rates for marketable and official debt targeted by Arellano and Barreto (2025). The parameter in the pricing kernel delivers a Sharpe ratio of marketable bond returns of 0.5. The lower bound for bond prices binds in less than 0.8% of the simulation samples and implies that the government cannot issue marketable debt at a spread higher than 13.4%. The portfolio adjustment cost is sufficient to prevent large portfolio adjustments, including buybacks, before defaults. The endowment process is calibrated to match GDP data for Pakistan between 1980 and 2019.

The parameters of the income cost of defaulting λ_0 and λ_1, and the discount factor β are calibrated targeting an average debt-to-GDP ratio of 59 percent (Pakistan 2000-2019) and a mean spread for sovereign bonds of 5.9 percent (Pakistan 2005-2019). As discussed by Hatchondo and Martinez (2017), λ_0 is the key parameter for matching the average debt level and λ_1 is the key parameter for matching the average spread level. A low enough value of β is needed to match the average spread level, and we select the maximum value of β that allows us to do so. We solve the model using value function iteration and interpolation (Hatchondo et al., 2010).

[10] Arellano and Barreto (2025) target an average duration of 10 years for official loans. We find problems with the convergence of our code for longer durations of official loans and target an average loan duration of 8.4 years to facilitate convergence.

Table 2: Business Cycle Statistics

Targeted moments		
	Model	Data
Mean Debt-to-GDP	59.2	59.0
Mean spread (r_s)	5.7	5.9
Non-Targeted moments		
$\sigma(c)/\sigma(y)$	1.5	1.6
$\sigma\left(r_s\right)$	1.2	3.7

Note: Debt levels in the simulations are calculated as the present value of future payment obligations discounted at the risk-free rate and reported as a percentage of annualized income. The standard deviation of x is denoted by $\sigma\left(x\right)$. Moments are computed Moments for the simulations correspond to the mean value of each moment in 500 simulation samples, with each sample including 60 periods (15 years) without a default episode. Simulation samples start at least five years after a default. Default episodes are excluded to improve comparability with the data. Consumption and income are expressed in logs.

2.5 Simulations

Table 2 shows that the model simulations match the targeted levels of debt and spread. The model also does a good job mimicking the standard deviation of consumption relative to income. As is common in quantitative studies of sovereign default, the model produces a relatively low volatility of the sovereign spread (this volatility is particularly high in Pakistan during the period under study).

2.6 The shock

The main purpose of this paper is to present a quantitative evaluation of proposals to use a sovereign debt standstill to mitigate the economic effects of large negative shocks (like COVID-19). The only shock in our stylized model is a shock to the endowment. Thus, we study debt relief after the economy suffers a large endowment shock.

The key for evaluating the benefits of a standstill is to capture shocks that impact the government's access to debt markets, which is reflected in the sovereign spread. Therefore, we focus on initial states with economic distress in which the cost of accessing debt markets is high. We assume that in the period where the policies are evaluated, the income shock is

$\varepsilon = -2.75\sigma_\varepsilon$. That shock implies a sovereign spread of about 300 basis points above average. This is consistent with Pakistan's sovereign spread increase of 302 basis points in the second quarter of 2020 (at the beginning of the COVID-19 pandemic).[11]

2.7 Official-creditor standstill

To model an official creditor standstill, we assume that during each standstill quarter, the official loan limit grows with the risk-free rate: $\bar{\ell}_{t+1} = \bar{\ell}_t\,(1+r)$ (in most states, the government borrows up to the limit of official loans). Under this assumption, each standstill year, the government has access to additional resources for 0.4% of average annual aggregate income. For Pakistan, the DSSI freed resources for 0.3% of GDP in 2020 and 0.5% of GDP in 2021. As shown in Figure 1, this is within the range of payment suspensions enjoyed by countries participating in the DSSI.[12] To avoid imposing the need for a consumption sacrifice at the end of the official standstill, we assume $\bar{\ell}$ stays at the increased level (for example, after a two-year official creditor standstill, the official loan limit is $\bar{\ell}(1+r)^8$) until the government declares a default. If the government defaults, the upper bound for official loans reverts to the benchmark level ($\bar{\ell}$).

Let's use the superscripts o, j to denote equilibrium functions in period j of a J-period official-creditor standstill. The government's value function at the beginning of a period after the official-creditor standstill started and before a sovereign default is given by

$$V^o\,(b, \ell, y, j) = \max_{d \epsilon \{0,1\}} \{dV_1(b, \ell, y) + (1-d)V_0^o(b, \ell, y, j)\},$$

where V_1 is the value function under default in the benchmark, and the value function under

[11]The working paper version of this work shows that our results are robust to different assumptions on the persistence of the initial shock, the government's ability to access debt markets during the standstill, the recovery rate for defaulted debt, and to using data from Mexico for calibrating the model.

[12]The DSSI was established in May 2020, and extended in October 2020 (until end-June 2021) and April 2021 (until end-2021). The payment suspension applied to both interest and principal due while the program was in place. All official bilateral lending was eligible for the iniciative (G20 and Paris Club, 2020). Although the Paris Club fully implemented the DSSI and its extensions, agreements were sometimes not concluded with other bilateral creditors (Paris Club, 2022), and thus the payments suspended during the DSSI represented only a fraction of the total bilateral lending. For example, suspended payments for Pakistan represented less than half of total bilateral payments for fiscal years 20/21 and 21/22 (IMF, 2022). Multilateral debt was not eligible for the DSSI. After the DSSI, debt levels in participating countries continued to increase, often indicating the need for debt restructurings (Georgieva and Pazarbasioglu, 2021).

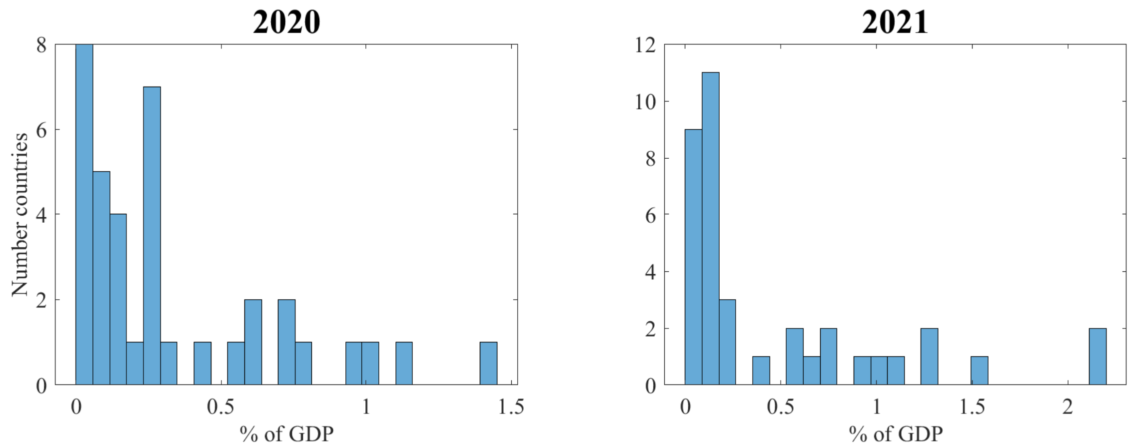

Figure 1: Magnitude of payment suspensions across the countries that participated in the DSSI. Source: World Bank.

repayment satisfies

$$
\begin{aligned}
V_0^o(b,\ell,y,j) = \max_{b'\geq 0,\ell'} & \left\{ u\left(c\right) + \beta \int V^o(b',\ell',y',j+1) F\left(dy' \mid y\right) \right\} \\
& \text{s.t.} \quad c = y - b - \ell + q^{b,o}(b',\ell',y,j)\left[b' - (1-\delta^b)b\right] + q^{\ell,o}(b',\ell',y,j)\left[\ell' - (1-\delta^\ell)\ell\right], \\
& q^{b,o}(b',\ell',y,j) \geq \underline{q} \; \forall \; b' > b(1-\delta^b), \text{ and} \\
& \ell' \in \begin{cases} \left[0, \bar{\ell}(1+r)^j\right] & \text{if } j = 1, ..., J \\ \left[0, \bar{\ell}(1+r)^J\right] & \text{otherwise.} \end{cases}
\end{aligned}
$$

Bond prices are determined by

$$
\begin{aligned}
q^{b,o}(b',\ell',y,j) = & \int M(y',y)\left[1 - \hat{d}^o\left(b',\ell',y',j+1\right)\right]\left[1 + (1-\delta^b) q^{b,o}(b'',\ell'',y',j+1)\right] F\left(dy' \mid y\right) \\
& + \int M(y',y)\, \hat{d}^o\left(b',\ell',y',j+1\right)\; q_D^b(b',\ell',y')\; F\left(dy' \mid y\right), \qquad (10) \\
& \text{with } b'' = \hat{b}^o(b',\ell',y',j+1),\ \ell'' = \hat{\ell}^o(b',\ell',y',j+1), \\
& \hat{b}^o(b',\ell',y',J+1) = \hat{b}(b',\ell',y'),\ \hat{\ell}^o(b',\ell',y',J+1) = \hat{\ell}(b',\ell',y'), \text{ and} \\
& q^{b,o}(b'',\ell'',y',J+1) = q^b(b'',\ell'',y').
\end{aligned}
$$

Similarly, loan prices are determined by

$$
\begin{aligned}
q^{\ell,o}(b',\ell',y,j) = & \int e^{-r}\left[1-\hat{d}^{o}\left(b',\ell',y',j+1\right)\right]\left[1+(1-\delta^{\ell})q^{\ell,o}(b'',\ell'',y',j+1)\right]F\left(dy'\mid y\right) \\
& + \int e^{-r}\,\hat{d}^{o}\left(b',\ell',y',j+1\right)\,q_{D}^{\ell}(b',\ell',y')\,F\left(dy'\mid y\right), \qquad (11) \\
& \text{with } b''=\hat{b}^{o}(b',\ell',y',j+1),\ \ell''=\hat{\ell}^{o}(b',\ell',y',j+1), \\
& \hat{b}^{o}(b',\ell',y',J+1)=\hat{b}(b',\ell',y'),\ \hat{\ell}^{o}(b',\ell',y',J+1)=\hat{\ell}(b',\ell',y'),\ \text{and} \\
& q^{\ell,o}(b'',\ell'',y',J+1)=q^{\ell}(b'',\ell'',y').
\end{aligned}
$$

Finally, bond and loan prices in default coincide with those in the benchmark model (i.e., without any standstills).

2.8 Private-creditor standstills

We assume that a private-creditor standstill consists of the following:

1. The period of the shock, private creditors and the government agree on a payment suspension for J periods, unless a default is declared during the standstill, in which case, the default puts an end to the standstill.

2. Each period during the standstill, the government is exempt from making debt payments to private creditors (official loan payments are not suspended) and the stock of private-creditor debt grows at the rate r^{DS}.

3. The government can issue debt during the standstill. Coupon payments of debt issued during the standstill start after the standstill is over (this allows us to analyze standstills without incorporating different debt instruments and thus additional endogenous state variables).

Let's use the superscript p to denote equilibrium functions during a private-creditor standstill, and $j \in [1, J]$ to denote the standstill period. The government's value function at the beginning of a standstill period is given by:

$$V^{p}\left(b,\ell,y,j\right)=\max_{d\in\{0,1\}}\{dV_1(\ell,y)+(1-d)V_0^{p}(b,\ell,y,j)\},$$

where

$$
\begin{aligned}
V_0^p(b,\ell,y,j) = \max_{b'\geq 0, \ell' \in [0,\bar{\ell}]} & \left\{ u\left(c\right) + \beta \int V^p(b',\ell',y',j+1) F\left(dy' \mid y\right) \right\} \\
\text{s. t. } & c = y - \ell + q^{b,p}(b',\ell',y,j)\left(b' - b\, e^{r^{DS}}\right) + q^{\ell,p}(b',\ell',y,j)\left[\ell' - (1-\delta^{\ell})\ell\right] \\
& q^{b,p}(b',\ell',y,j) \geq \underline{q} \quad \forall \quad b' > b\, e^{r^{DS}}, \text{ and} \\
& V^p(b',\ell',y',J+1) = V(b',\ell',y')
\end{aligned}
$$

The bond price for any period $j < J$ is given by

$$
\begin{aligned}
q^{b,p}(b',\ell',y,j) = & \int M(y',y)\left[1 - \hat{d}^p\left(b',\ell',y',j+1\right)\right] e^{r^{DS}} q^{b,p}(b'',\ell'',y',j+1) F\left(dy' \mid y\right) \\
& + \int M(y',y)\; \hat{d}^p\left(b',\ell',y',j+1\right)\; q_D^b(b',\ell',y')\; F\left(dy' \mid y\right) \\
& \text{with } b'' = \hat{b}^p(b',\ell',y',j+1) \text{ and } \ell'' = \hat{\ell}^p(b',\ell',y',j+1).
\end{aligned}
$$

In the last period of the private-creditor standstill, the bond price is:

$$
\begin{aligned}
q^{b,p}(b',\ell',y,J) = & \int M(y',y)\left[1 - \hat{d}\left(b',\ell',y'\right)\right]\left[1 + (1-\delta^b) q^b(b'',\ell'',y')\right] F\left(dy' \mid y\right) \\
& + \int M(y',y)\; \hat{d}\left(b',\ell',y'\right)\; q_D^b(b',\ell',y')\; F\left(dy' \mid y\right) \\
& \text{with } b'' = \hat{b}(b',\ell',y') \text{ and } \ell'' = \hat{\ell}(b',\ell',y').
\end{aligned}
$$

The loan price is given by:

$$
\begin{aligned}
q^{\ell,p}(b',\ell',y,j) = & \int e^{-r}\left[1 - \hat{d}^p\left(b',\ell',y',j+1\right)\right]\left[1 + (1-\delta^{\ell}) q^{\ell,p}(b'',\ell'',y',j+1)\right] F\left(dy' \mid y\right) \\
& + \int e^{-r}\; \hat{d}^p\left(b',\ell',y',j+1\right)\; q_D^{\ell}(b',\ell',y')\; F\left(dy' \mid y\right) \qquad (12) \\
& \text{with } b'' = \hat{b}^p(b',\ell',y',j+1),\;\; \ell'' = \hat{\ell}^p(b',\ell',y',j+1),\;\; \hat{b}^p(b',\ell',y',J+1) = \hat{b}(b',\ell',y'), \\
& \hat{\ell}^p(b',\ell',y',J+1) = \hat{\ell}(b',\ell',y') \text{ and } q^{\ell,p}(b'',\ell'',y',J+1) = q^{\ell}(b'',\ell'',y').
\end{aligned}
$$

As before, bond and loan prices in default coincide with those in the benchmark economy. We assume that payments suspended during a private-creditor standstill earn the average yield of sovereign bonds in the simulations, $r^{DS} = 2.44\%$, which is equal to the risk-free rate plus the average (quarterly) spread. The growth rate of suspended payments assumes that creditors do not make losses in present value as long as the average default rate is unaffected by the standstill. Thus, our assumption is consistent with the stated intention of implementing standstills that do not produce losses to creditors (we later discuss creditors' losses in detail).[13] Analyzing different values of r^{DS} is equivalent to introducing write-offs, which we do in Section 3.2.2.

3 Results

This section evaluates the effects of official-creditor and private-creditor standstills after the economy suffers an adverse income shock. We show that (i) official-creditor standstills generate a spread decline consistent with the one observed in the data after the implementation of the DSSI; (ii) private-creditor standstills generate welfare gains for the sovereign but create losses for private creditors (which is consistent with their reluctance to offer terms comparable to those in the DSSI); and (iii) for private-creditor debt relief, debt write-offs dominate standstills (which is at odds with the reluctance to include write-offs in debt relief proposals).

3.1 Official-creditor standstills

Panel (a) of Figure 2 shows that model simulations can account for the decline in sovereign spreads triggered by the DSSI. For an income shock that generates a spread increase of 303 basis points on average, introducing a two-year official standstill moderates the initial spread increase: The same shock generates a spread increase of 247 basis points with an official standstill in place. The effect on spreads of the official-creditor standstill in panel (a) of Figure 2 is comparable to the effect found for Pakistan by Lang et al. (2023) (which is lower than the median effect of 150 basis points they find for all the countries in their sample). Lang et al. (2023) also document that the spread decline is stronger for countries that received more relief, had a shorter debt maturity, and had a weaker initial fiscal position.

[13]The DSSI terms specify that "suspension of payments will be NPV-neutral." The IMF-World Bank DSSI Note states that the "DSSI provides an NPV-neutral debt rescheduling... using the interest rate set in the original loan contract."

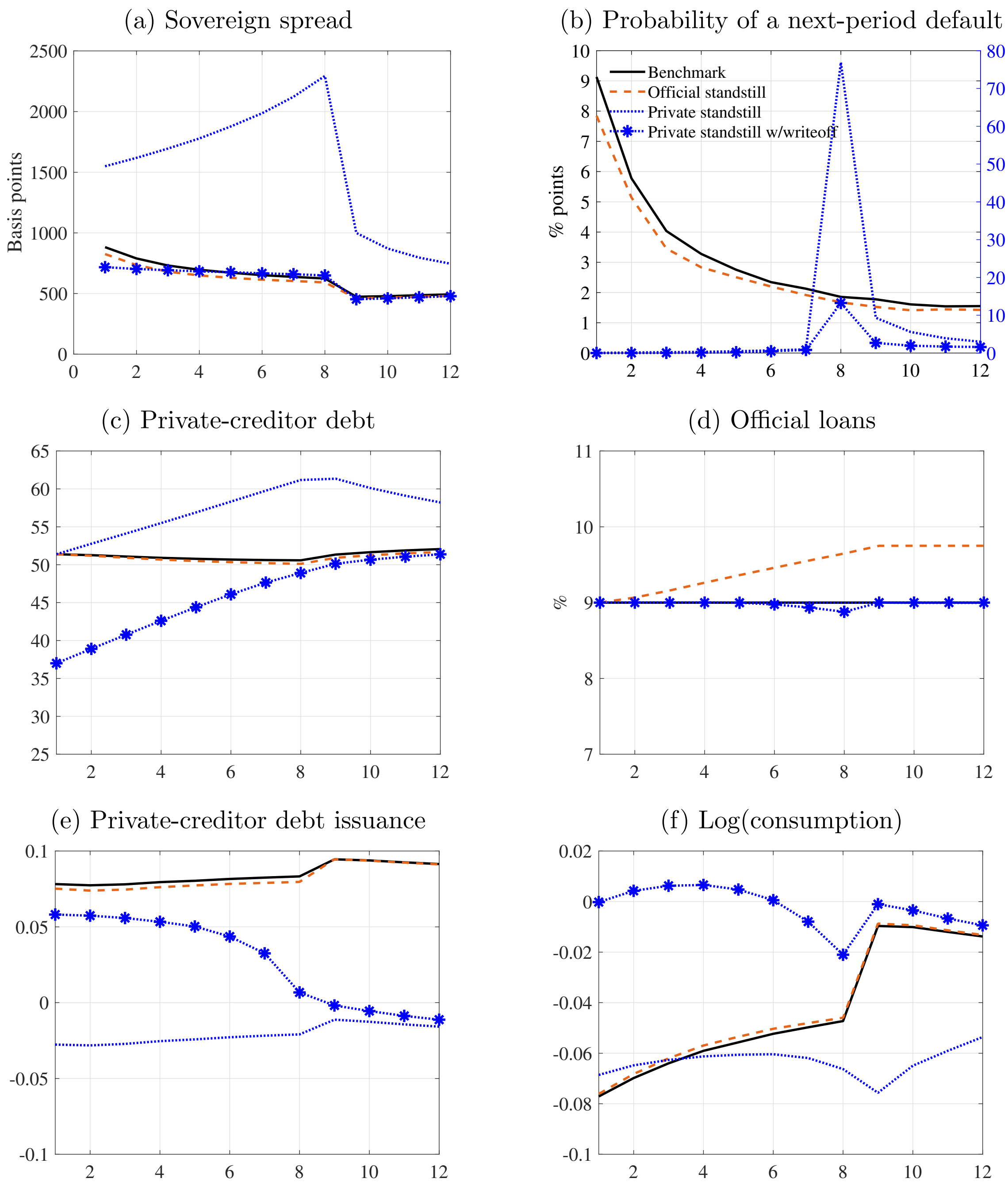

Figure 2: Transition dynamics. The graphs show average transition paths computed as follows. First, we generate 10,000 samples of 300 periods each for the benchmark economy. We use the last observations as period zero of the transition paths. Second, we generate transition paths with initial income $\log(y_{i,1}) = (1-\rho)\mu + \rho \log(y_{i,0}) - 2.75\sigma_\varepsilon$ for each sample. The initial income shock generates a 303 basis points spread increase in $t = 1$, on average. Third, we extract the sample paths without defaults prior to each period in the four economies and with initial market debt levels within the range of values observed in the simulations used to compute Table 2. The exception is panel (b), which is computed assuming no defaults prior to each period for each economy being plotted. Debt (and loan) levels are presented as a percentage of mean annual income. The curves with a private standstill and a write-off assume a write-off of 30%.

The spread decline is explained by the weaker default incentives during the official standstill, as shown in panel (b) of Figure 2. The higher consumption and lower market debt enabled by the official-creditor standstill (panels [c] and [f]) make repaying relatively more attractive than defaulting.

3.2 Private-creditor standstills

Next, we evaluate the effects of a standstill with private creditors. The G20 and others called for private creditors to participate in the DSSI with terms comparable to those offered by official creditors. On May 28, 2020, the International Institute of Finance released Terms of Reference to facilitate voluntary private sector involvement in the DSSI. Bolton et al. (2020) and Weidemaier and Gulati (2020) argue that while private creditors participation in the debt standstill was needed, voluntary private creditors participation could not be expected. However, they explain that the "doctrine of necessity" in public international law recognizes that sovereigns may sometimes need to respond to exceptional circumstances that are unforeseen, unpredictable, and unavoidable, by suspending the normal performance of their contractual obligations. Gelpern et al. (2020) discuss how Collective Action Clauses could be used to implement a standstill. Bolton et al. (2021) explain that the reverse acceleration provision could be used to prevent attempts to accelerate the sovereign's debt.[14] At the end, there was no meaningful participation of private creditors, which is consistent with the findings described below.

Panel (a) of Figure 2 illustrates how in contrast with the official-creditor standstill that reduces sovereign spreads, a standstill with private creditors further increases sovereign spreads by around 970 basis points on average. This spread increase is substantial because: (i) As illustrated in the left panel of Figure 3, after a severe adverse shock, bond prices (and thus spreads) are more sensitive to changes in debt levels (and expected future debt levels), and (ii) as illustrated in panel (c) of Figure 2, investors anticipate a substantial increase in the stock of debt.[15] For example, after a two-year private-creditor standstill, the ratio of market

[14] Bolton et al. (2020) and Gelpern et al. (2020) also argue that in response to COVID-19, standstills should be extended to middle income countries. Bolton et al. (2020) explain that even the absence of private sector participation, official debt relief could help service private creditor claims.

[15] The increased sensitivity of bond prices to debt levels after adverse shocks is a standard feature of

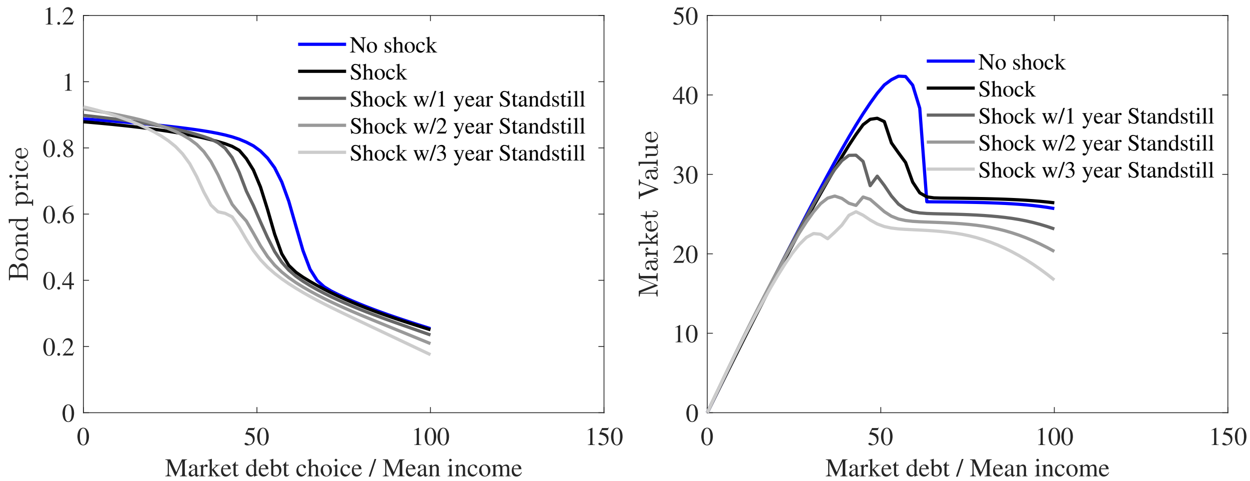

Figure 3: Effects of introducing a private-creditor standstill on the price of bonds and the market value of private-creditor debt. The lines with no income shock assume an initial income equal to the mean in the simulations. The income shock in the remaining lines represents a decline of $2.75\sigma_{\varepsilon}$. The initial debt level is the average in the simulations. The sharp changes in the slopes of the market value curves correspond to initial debt levels at which the lower bound for the bond price binds.

debt to (annual) income increases by more than 10 percentage points relative to the path without the standstill. Because of the worse credit conditions after the negative shock, market debt levels do not increase significantly in the benchmark without a standstill, and the official creditor standstill does not have a significant effect on the level of market debt. In contrast, market debt levels increase substantially with the private-creditor standstill because of the accumulation of postponed coupon payments (as illustrated in panels [c] and [e] of Figure 2, with the private-creditor standstill, market debt levels are higher despite lower market debt issuances).

Panel (b) of Figure 2 shows that with the private-creditor standstill, spreads increase because of a very significant increase in the default probability when the standstill is over. The default probability is close to zero during the standstill. After the standstill, the government

default models. While it is challenging to test empirically how the effect of debt on the bond price (or the sovereign spread) changes in crises, existing evidence is consistent with this feature. Jaramillo and Tejada (2011) document that the spread is more sensitive to increases in external public debt in countries without investment grade (which is correlated with higher spreads that are in turn correlated with lower levels of aggregate income and higher levels of debt). David et al. (2019) find that the decline in spread after the announcement of fiscal consolidations is larger when the spread was already high prior to the announcement. Hatchondo et al. (2020a) document that the spread increases more with debt in years with high spread. Bi and Traum (2020) find a more significant effect of fiscal information on bond prices during crises. Gu and Stangebye (2023) present similar findings.

starts facing the much higher debt service obligations implied by the increased debt levels.

The left panel of Figure 3 shows that the bond price also becomes more sensitive to debt levels with a longer private-creditor standstill, which implies higher expected debt levels and, thus, higher default probabilities. In sum, our findings show that implementing a private-creditor standstill would have effects on default risk and market access opposite to those observed under an official standstill.

3.2.1 Welfare gains and private creditors' capital losses

As illustrated in Figure 4, private-creditor standstills generate significant welfare gains for the sovereign, and these gains increase with the duration of the standstill. The government benefits from a standstill for two reasons. Firstly, the expected discounted value—for the sovereign—of servicing the postponed payments declines. Even though the postponed coupon payments accrue an interest of r^{DS}, it is still the case that $\beta e^{r^{DS}} < 1$, implying that the sovereign discounts delayed payments more heavily than the rate at which delayed payments grow. Secondly, the payments that were due during the standstill are replaced by future payments with a higher default probability (panel [b] of Figure 2). Since creditors are not properly compensated for the higher default probability of these future payments, the sovereign benefits because it pays less of that extra debt in expectation.[16] The Appendix offers an analytical characterization of the welfare effects of standstills in a two-period model.

Figure 4 also illustrates how a standstill can generate significant capital losses for creditors. The private-creditor standstill increases spreads significantly (panel [a] of Figure 2), thereby generating a decline in the market value of bonds, as illustrated in the right panel of Figure 3.[17] Creditors' capital losses increase with the duration of the standstill. This occurs

[16] The sovereign incurs higher default costs as it defaults more often, but given that the default decision is strategic, the extra "savings" on future unpaid debt offsets the additional costs of defaulting.

[17] Without a standstill, the market value of debt claims in the benchmark economy is measured as

$$MV(b,\ell,y) = b\left[1-\hat{d}(b,\ell,y)\right]\left[1+(1-\delta^b)q^b(\hat{b}(b,\ell,y),\hat{\ell}(b,\ell,y)y)\right] + b\,\hat{d}(b,\ell,y)\;q^b_D(b,\ell,y).$$

Similarly, with a private-creditor standstill, the market value of debt claims is measured as

$$MV^p(b,\ell,y,j) = b\left[1-\hat{d}^p(b,\ell,y,j)\right]e^{r^{DS}}q^{b,p}(\hat{b}^p(b,\ell,y,j),\hat{\ell}^p(b,\ell,y,j),y,j) + b\,\hat{d}^p(b,\ell,y,j)\;q^b_D(b,\ell,y).$$

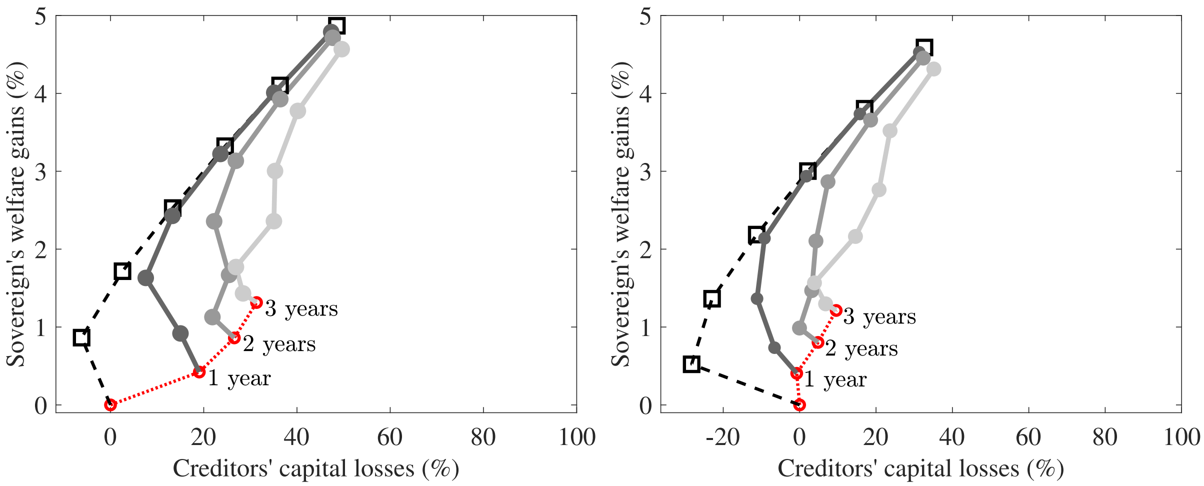

Figure 4: Sovereign's welfare gains and creditors' capital losses from introducing a private-creditor standstill. The red curve corresponds to standstills without write-offs. In the other curves, from bottom to top, each mark represents an increase in the fraction of debt written off of 10 percentage points. Welfare gains are measured as the equivalent per-period permanent consumption increase. The initial debt portfolio coincides with the average portfolio in the simulations. In the left (right) panel, initial income is at the average level minus $2.75\sigma_\varepsilon$ ($4.25\sigma_\varepsilon$). Without a private-creditor standstill, the income shock on the right panel triggers a default.

because debt payments postponed for a longer period lead to even higher future debt levels and, therefore, higher future default probabilities.

Bondholders are not properly compensated for the increase in the default probability not only of postponed payments but also on all other payments. For example, recall that in panel (a) of Figure 2, the spread increases 970 basis points because of the private-creditor standstill. Thus, the post-standstill spread is over 1500 basis points, and the compensation to private creditors for postponed payments only reflects the average spread of 590 basis points (which is even lower than the post-shock no-standstill spread). Private creditors' capital losses are consistent with their reluctance to participate in standstills and indicate that this reluctance would persist even without the free-riding or holdout problem often emphasized in policy discussions. Although a private-creditor standstill would benefit the sovereign, it may be difficult to convince private creditors to accept this standstill (as occurred after COVID-19).

3.2.2 Write-offs

The previous subsection established that standstills can produce welfare gains for the sovereign but, at the same time, result in capital losses for creditors. Following existing proposals, we have assumed so far that there is no write-off in the face value of sovereign debt. In this subsection, we focus on the possibility of combining standstills with write-offs (a reduction of the nominal level of the sovereign's indebtedness). After a write-off of ω in period t, the profile of debt obligations becomes $\left\{b_t(1-\omega), b_t(1-\delta^b)(1-\omega), b_t(1-\delta^b)^2(1-\omega), \ldots\right\}$.

Figure 4 shows that, in contrast with the policymakers' aversion to write-offs, combining private-creditor standstills with write-offs can produce Pareto improvements for the sovereign and creditors (as a group). This is, combining standstills with write-offs can simultaneously reduce the capital losses triggered by the standstill and increase the sovereign's welfare gains. For example, in the left panel of Figure 4, adding to the two-year private-creditor standstill a debt write-off of 30% eliminates 16% of creditors' capital losses while more than doubling the sovereign's welfare gains. Furthermore, even if no standstill was extended, a 10% write-off would simultaneously generate capital gains for creditors and welfare gains for the sovereign. These welfare gains for the sovereign would be almost as large as those generated by a two-year private-creditor standstill without write-offs, which would generate creditors' capital losses of almost 40%.

While write-offs are often referred to as a measure of creditors' losses, our analysis illustrates how write-offs are a measure of debt relief for the sovereign but could produce (capital) gains for creditors. Let us focus on the two-year standstill in the left panel of Figure 4. There is an agreement zone for write-offs up to 30%: Both the sovereign and creditors (as a group) benefit from higher write-offs. Thus, any write-off lower than 30%, including the standstill without a write-off, would be an inefficient debt relief from the perspective of the sovereign's welfare and the creditors' capital losses. For write-offs larger than 30%, there is disagreement: While the sovereign prefers higher write-offs, lenders prefer lower write-offs.

The right panel of Figure 3 illustrates the "debt Laffer curve:" The market value of debt is hump-shaped in debt. The market value initially increases with the debt stock until a point in which additional debt produces a large enough decline in bond prices (owing to higher default probabilities). As illustrated in the left panel of Figure 3, for higher debt levels, bond prices tend to decrease more dramatically with an increase in the debt level.

The right panel of Figure 3 also illustrates how the debt level that maximizes the debt market value decreases with negative shocks and with the duration of the standstill. This implies that after an adverse shock and with a longer standstill, it is more likely that the initial debt stock is on the decreasing region of the debt Laffer curve. Therefore, both large shocks and higher expected levels of market debt caused by a standstill generate a situation of debt overhang and thus the opportunity of Pareto gains from write-offs: a debt reduction increases the debt market value, generating capital gains for debt holders.

As illustrated in Figure 4, we find that pure write-offs tend to dominate standstills. This is, for any level of creditors' capital losses, a pure write-off achieves a larger welfare gain than combining the write-off with a standstill. However, note that for sufficiently large write-offs, the welfare loss from combining the write-off with a standstill is negligible. For example, in the left panel of Figure 4, for write-offs above 30 percent, adding a one-year standstill to the write-off does not change welfare or capital losses substantially. This occurs because for the low debt levels implied by sufficiently large write-offs, the standstill is not expected to increase market debt levels significantly above the levels in the write-off-only scenario. Therefore, standstills do not produce significant inefficiencies in debt relief.

Why are write-offs more efficient than standstills in providing debt relief? There are two mechanisms that can account for this result (see also Proposition 5 in the Appendix). Firstly, as discussed before and illustrated in panel (b) of Figure 2, without write-offs, a standstill only achieves a temporary decline in the default probability, with a sharp increase in this probability when the standstill ends. In contrast, with write-offs, the default probability continues to be lower than in the benchmark after the standstill ends. Thus, without write-offs, the higher expected default risk associated with standstills implies higher expected deadweight losses from defaults, which hurt the sovereign but do not benefit its creditors. Write-offs reduce expected default risk and thus the expected deadweight losses from defaults, creating a surplus to be shared between the sovereign and creditors.[18] Secondly, by lowering default risk, write-offs improve current borrowing opportunities, allowing the sovereign to attain higher consumption (panel [f] of Figure 2).[19]

[18] Recall that there is an inefficiency associated with defaults: The sovereign suffers costs that do not benefit creditors.

[19] Note that one potential disadvantage of write-offs compared with standstills is that in the short-run, with only a write-off, the sovereign keeps making payments that it would not make under a standstill. This could make consumption lower with the write-off than with the standstill. While this does not occur in our simulations, it is still a theoretical possibility. Even if this is the case, if the sovereign is sufficiently patient, the lower expected deadweight costs of defaulting outweigh the possible short-run consumption

Table 3: Debt relief and creditor losses

Write-off	Capital loss	Haircut
0.00	30.87	13.42
10.00	26.23	17.07
20.00	28.00	23.83
30.00	25.87	29.66
40.00	30.96	38.11
50.00	40.19	47.81
60.00	50.92	57.92

Note: In percent. Income is at the average level minus two standard deviations and the initial debt level is the average in the simulations. Write-offs are done in addition to a two-year private-creditor standstill.

Overall, our results cast doubts on the emphasis on avoiding write-offs for standstills. The costs of avoiding write-offs should be even stronger after large shocks such as COVID-19, with both large shocks and standstills likely to create situations of debt overhang and thus opportunities for Pareto gains from write-offs.

3.2.3 Haircuts

Table 3 reports the model-implied present-value haircuts of introducing a two-year private-creditor standstill combined with write-offs of different magnitudes. The haircut, often discussed in academic and policy circles (see, for example, Sturzenegger and Zettelmeyer, 2008), is defined as:

$$1 - \frac{\sum_{t=1}^{\infty} x_t^{Post} e^{-it}}{\sum_{t=1}^{\infty} x_t^{Pre} e^{-it}}, \tag{13}$$

where x_t^{Post} denotes the post-restructuring debt payment obligations in period t, x_t^{Pre} denotes the pre-restructuring debt payment obligations in period t, and i denotes the post-restructuring bond yield.

Table 3 shows that a standstill without a write-off still carries a significant haircut of 13.4%. This occurs because the exit yield used for computing the haircut is higher than

decline implied by debt payments, and write-offs dominate standstills (Proposition 5 in the Appendix).

the rate earned by payments postponed in the standstill, which depend on the average pre-standstill spread.

Table 3 also illustrates a significant discrepancy between the capital loss and the haircut as a measure of the effect of debt relief on creditors. For example, increasing the write-off from 10% to 30% increases the haircut from 17.1% to 29.7%, but lowers the capital loss from 26.2% to 25.9%. This occurs because by comparing capital losses, we are considering that increasing the write-off lowers default risk and, therefore, lowers the spread and increases the market value of debt holdings. In contrast, the haircut only considers the exit yield and, therefore, it does not fully capture the benefits from lowering this yield (because it does not compare it with the yield that would prevail without the debt relief). This is why throughout the paper we focus on capital losses, which seem the better measure of the investors' losses implied by debt relief. This discrepancy between haircuts and capital losses is consistent with the one observed in restructuring episodes. In Hatchondo et al. (2014), we show that in six restructuring episodes (Belize 2007, Dominican Republic 2005, Greece 2012, Pakistan 1999, Ukraine 2000, and Uruguay 2003), haircuts ranged from 5% to 65%, but in all cases there were capital gains (measured at the deadline of the original exchange offer) ranging between 3% and 14%. This is also consistent with the debt overhang in our simulations (which is exacerbated by the standstill).

4 Conclusions

This paper first shows that a standard default model can account for the decline in sovereign spreads triggered by the Debt Service Suspension Initiative (DSSI) implemented by the G20 for bilateral official debt during the COVID-19 pandemic (Lang et al., 2023). The paper also shows that in contrast with the DSSI, a private-creditor standstill tends to produce a significant increase in sovereign spreads and thus, sizable capital losses for debt holders. Thus, the model can also account for the private creditors' reluctance to participating in a debt standstill, as was widely advocated during COVID-19 (Bolton et al., 2020, 2021; Gelpern et al., 2020; and Weidemaier and Gulati, 2020).

The findings in this paper also cast doubts on the emphasis on sovereign debt standstills without write-offs as the best alternative for providing debt relief to countries affected by adverse shocks, such as those associated with the COVID-19 outbreak. Standstills increase debt and thus increase default risk when the payment suspension ends. In contrast, write-offs provide debt relief while reducing default risk. Thus, by lowering the associated deadweight costs of defaulting, write-offs create a surplus to be shared between the sovereign and creditors. The paper shows that the benefits of write-offs are even larger when standstills produce a sovereign debt overhang and adding write-offs to standstills can improve the government's welfare while lowering creditors' losses. To the extent that the emphasis on standstills without write-offs is the result of the regulatory cost of reductions in the nominal value of debt holdings (Dvorkin et al., 2021) or the emphasis on payment suspensions in the doctrine of necessity (Bolton et al., 2020, 2021; Weidemaier and Gulati, 2020), our results underscore that these legal frameworks could create significant inefficiencies in debt relief outcomes.

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Appendix

A A two-period model

We next present a stylized two-period model that illustrates why write-offs may be preferable over standstills for providing debt relief. We show that by lowering future debt, and thus, by lowering the future default probability, write-offs reduce the deadweight cost of defaulting more than a standstill. We also show that write-offs can dominate a standstill even when we assume a sudden stop in the first period. Intuitively, standstills tend to generate a short-term gain at the expense of a long-term loss due to additional debt accumulation. Therefore, the key property for preferring a write-off over a standstill is that the sovereign is not too impatient.

Environment. There are two periods, 1 and 2. Both the government and lenders are risk neutral. Lenders operate in a competitive environment and have a discount factor of 1. The government's discount factor is denoted by $\beta \in (0, 1)$, and its initial debt is given by $b > 0$ legacy bonds. Each legacy bond pays a coupon of δ units in period 1 and a principal of 1 unit in period 2. Bonds issued in period 1 promise to pay 1 unit in period 2. The borrower can default in period 2 (we abstract from default incentives in period 1). There is a stochastic resource/utility cost of defaulting ϕ with support $[0, \bar{b}]$. The pdf for ϕ is denoted by f and its cdf by F. The density f is continuous, and $f > 0$ for all $\phi \in [0, \bar{b}]$. There is no income.

Value under repayment. The government defaults in period 2 if its debt is higher than the cost of defaulting ($b > \phi$). Thus, the government repays b with probability $1 - F(b)$ and its expected utility in default states is $-\int_0^b \phi f(\phi) d\phi$. This implies that in period 1, when the government starts with b bonds, it expects a continuation value of

$$V(b) = \underset{b' \in [0, \bar{b}]}{Max} \left\{ \underbrace{-\delta b + q(b')\,(b' - b)}_{c} - \beta[1 - F(b')]b' - \beta \int_0^{b'} \phi f(\phi) d\phi \right\}. \tag{A.1}$$

Risk-neutrality and $\beta < 1$ imply the government has no incentive to save. Given that we are going to focus on cases with $b > 0$, the constraint $b' \geq 0$ is not binding. The objective function is flat in b' for $b' \geq \bar{b}$, so the constraint $b' \leq \bar{b}$ is not restrictive. We are going to use $\hat{b}$ to denote the optimal borrowing rule of the problem above.

Bond price. Competition between lenders ensures that the equilibrium bond price schedule satisfies

$$q(b') = 1 - F(b').$$

Standstill. A debt standstill consists on postponing the payment of the δb coupons maturing in period 1. The value of repaying with a standstill satisfies

$$V^{DS}(b) = \underset{b' \in [0,\bar{b}]}{Max} \left\{ q(b') \left[b' - b(1+\delta) \right] - \beta [1 - F(b')] b' - \beta \int_0^{b'} \phi f(\phi) d\phi \right\}. \tag{A.2}$$

Let $\hat{b}^{DS}$ denote the optimal borrowing rule with a standstill.

The next lemma establishes useful properties for the propositions that follow. It shows the continuity of functions V and V^{DS}, and that the optimal borrowing is interior and continuous. For the latter, we need the following assumption.

Assumption 1 *The density f is such that*

$$[1 - F(b')] (b' - b) - \beta [1 - F(b')] b' - \beta \int_0^{b'} \phi f(\phi) d\phi$$

is strictly concave for all $b > 0$.[20]

Lemma 2 *Given Assumption 1, the functions V and V^{DS} are continuous in b and β. The borrowing rule $\hat{b}(b) \in (0, \bar{b})$ for $b \in [0, \bar{b})$ and is continuous. The borrowing rule $\hat{b}^{DS}(b) \in (0, \bar{b})$ for $b \in [0, \bar{b}/(1+\delta))$.*

Proof. The continuity of $\left\{ V, V^{DS}, \hat{b} \right\}$ follows from the continuity of the objective functions in problems (A.1)-(A.2), the compactness and continuity of the choice set $[0, \bar{b}]$, the strict concavity of the objective function in equation (A.1), and the theory of the maximum.

The first order derivative of the objective function in equation (A.1) is

$$[1 - F(b')] (1 - \beta) - f(b') (b' - b) > 0 \quad \forall b' \leq 0 \text{ and } b \geq 0,$$

[20]An example of such probability distribution is the uniform one.

implying that $\hat{b}(b) > 0$.

Since $f(\bar{b}) > 0$, the first order derivative

$$[1 - F(b')]\,(1-\beta) - f(b')\,(b' - b) < 0 \quad \text{evaluated at } b' = \bar{b} \text{ and for } b < \bar{b},$$

implying that $\hat{b}(b) < \bar{b}$.

The proof for $\hat{b}^{DS}(b) \in (0, \bar{b})$ is analogous. ■

In what follows, we restrict attention to initial debt levels $b \in [0, \bar{b}/(1+\delta))$, which ensures the first order conditions hold with equality. The next proposition shows that both, standstills and write-offs are welfare enhancing for the government.

Proposition 3 *$V^{DS}(b) > V(b)$ and $V(b(1-\omega)) > V(b)$ for all $b \in [0, \bar{b}/(1+\delta))$ and write-off magnitudes $\omega \in (0,1)$.*

Proof.

$$\begin{aligned}
V(b) &= -\delta b - q\left(\hat{b}(b)\right) b + q\left(\hat{b}(b)\right)\hat{b}(b) - \beta[1 - F(\hat{b}(b))]\hat{b}(b) - \beta\int_0^{\hat{b}(b)} \phi f(\phi)d\phi \\
&< -\delta b q\left(\hat{b}(b)\right) - q\left(\hat{b}(b)\right) b + q\left(\hat{b}(b)\right)\hat{b}(b) - \beta[1 - F(\hat{b}(b))]\hat{b}(b) - \beta\int_0^{\hat{b}(b)} \phi f(\phi)d\phi \\
&\leq -q\left(\hat{b}^{DS}(b)\right) b(1+\delta) + q\left(\hat{b}^{DS}(b)\right)\hat{b}^{DS}(b) - \beta[1 - F(\hat{b}^{DS}(b))]\hat{b}^{DS}(b) - \beta\int_0^{\hat{b}^{DS}(b)} \phi f(\phi)d\phi \\
&= V^{DS}(b)
\end{aligned}$$

where the second line follows from $\hat{b}(b) > 0$ and, thus, $q\left(\hat{b}(b)\right) < 1$, and the third line follows from the definition of $\hat{b}^{DS}$.

The inequality $V(b(1-\omega)) > V(b)$ is trivial.

■

Proposition 3 shows that both debt-relief policies increase the government's welfare. We next examine which of these two policies can increase the government's welfare more, while imposing the same loss to creditors. For that, we will need the following Lemma.

Lemma 4 *The borrowing policy $\hat{b}(b)$ is strictly increasing and $\hat{b}^{DS}(b) > \hat{b}(b)$ for all $b \in [0, \bar{b}/(1+\delta))$ and write-off percentages $\omega \in (0,1)$.*

Proof. Let $0 \leq b_0 < b_1 < \bar{b}/(1+\delta)$. In order to simplify notation, let $b'_i = \hat{b}(b_i)$ for $i = 0, 1$.

First, the optimality of b_0' for $b = b_0$ implies

$$-\left(\delta + 1 - F(b_0')\right) b_0 + \left(1 - F(b_0')\right)(1-\beta)b_0' - \beta \int_0^{b_0'} \phi f(\phi) d\phi -$$
$$\left[-\left(\delta + 1 - F(b')\right) b_0 + \left(1 - F(b')\right)(1-\beta)b' - \beta \int_0^{b'} \phi f(\phi) d\phi\right] \geq 0 \text{ for all } b' \leq b_0',$$

which is equivalent to

$$[F(b_0') - F(b')]\, b_0 + (1-\beta)\left[\left(1 - F(b_0')\right) b_0' - \left(1 - F(b')\right) b'\right] - \beta \int_{b'}^{b_0'} \phi f(\phi) d\phi \geq 0 \text{ for all } b' \leq b_0'. \tag{A.3}$$

Equation A.3 and $F(b_0') - F(b') \geq 0$ imply

$$[F(b_0') - F(b')]\, b_1 + (1-\beta)\left[\left(1 - F(b_0')\right) b_0' - \left(1 - F(b')\right) b'\right] - \beta \int_{b'}^{b_0'} \phi f(\phi) d\phi \geq 0 \text{ for all } b' \leq b_0'. \tag{A.4}$$

Inequality A.4 implies that $b_1' \geq b_0'$.

The derivative of the objective function for initial debt $b = b_1$ at $b' = b_0'$ is

$$[1 - F(b_0')](1-\beta) - f(b_0')(b_0' - b_1) > \underbrace{[1 - F(b_0')](1-\beta) - f(b_0')(b_0' - b_0) = 0}_{\text{First order condition for } b' \text{ with initial debt } b=b_0}, \tag{A.5}$$

implying that the objective function is strictly increasing at $b' = b_0$ when the government enters period 1 with $b = b_1$. Equations (A.4)-(A.5) imply $b_1' > b_0'$.

Regarding the second part of the lema, notice that debt payments in period 1 do not affect optimal borrowing. Thus,

$$\begin{aligned}
\hat{b}^{DS}(b) &= \underset{b'}{Argmax}\left\{q(b')\left(b' - b(1+\delta)\right) - \beta[1 - F(b')]b' - \beta \int_0^{b'} \phi f(\phi) d\phi\right\} \\
&= \underset{b'}{Argmax}\left\{-\delta(1+\delta)b + q(b')\left(b' - b(1+\delta)\right) - \beta[1 - F(b')]b' - \beta \int_0^{b'} \phi f(\phi) d\phi\right\} \\
&= \hat{b}(b(1+\delta)).
\end{aligned}$$

From the first part of the lemma, we know $\hat{b}(b(1+\delta)) > \hat{b}(b)$. ■

Intuitively, Lemma 4 follows from the stronger incentives to dilute debt when the government enters a period with higher debt. The stronger incentives to issue debt with a standstill lead the government to issue debt at a lower price. This unequivocally lowers the market value of debt because i) a standstill swaps a sure coupon payment δb in $t = 1$ for an uncertain payment in $t = 2$, and ii) the payment due at $t = 2$ is subject to a higher default probability. This capital loss resembles ones shown in Figure 4.

The next proposition shows the main result of the paper through the lens of the stylized model. It shows why write-offs may dominate standstills. Formally, the proposition establishes that when the sovereign is sufficiently patient, we can always find a write-off that leaves lenders indifferent between the write-off and the standstill, while leaving the sovereign strictly better off than with the standstill.

Proposition 5 *For any $b \in [0, \bar{b}/(1+\delta))$, there exists a cutoff $\underline{\beta}(b)$ and write-off ω^* such that:*

$$V\left(b(1-\omega^*)\right) > V^{DS}(b), \text{ and}$$
$$b(1-\omega^*)\left[\delta + q\left(\hat{b}(b(1-\omega^*))\right)\right] = bq\left(\hat{b}^{DS}(b)\right)(1+\delta), \quad \text{for all } \beta \in (\underline{\beta}(b), 1).$$

Proof.

Since creditors experience a capital loss with a standstill, i.e.,

$$bq\left(\hat{b}^{DS}(b)\right)(1+\delta) < b\left[\delta + q\left(\hat{b}(b)\right)\right],$$

and the market value is a continuous function, it is always possible to find a write-off $\omega^* \in (0,1)$ that replicates the capital loss generated by the standstill. Using $b'_{\omega^*} = \hat{b}(b(1-\omega^*))$ and $b'_{DS} = \hat{b}^{DS}(b)$, the differential welfare effect for the sovereign

$$\begin{aligned}
V\left(b(1-\omega^*)\right) - V^{DS}(b) = &- b(1-\omega^*)[\delta + q(b'_{\omega^*})] + q(b'_{\omega^*})b'_{\omega^*} - \beta\left[1 - F(b'_{\omega^*})\right]b'_{\omega^*} - \beta\int_0^{b'_{\omega^*}} \phi f(\phi)d\phi - \\
&\left[-bq(b'_{DS})(1+\delta) + q(b'_{DS})b'_{DS} - \beta\left[1 - F(b'_{DS})\right]b'_{DS} - \beta\int_0^{b'_{DS}} \phi f(\phi)d\phi\right] \\
= &\underbrace{[q(b'_{\omega^*})b'_{\omega^*} - q(b'_{DS})b'_{DS}]}_{c_1(b(1-\omega^*)) - c_1^{DS}(b)}(1-\beta) + \beta \times \underbrace{\int_{b'_{\omega^*}}^{b'_{DS}} \phi f(\phi)d\phi}_{E\left[c_2(b(1-\omega^*)) - c_2^{DS}(b)\right] > 0} = g(\beta).
\end{aligned} \tag{A.6}$$

At $\beta = 1$, the government does not have an incentive to save nor borrow and, therefore, chooses $b'_{\omega^*} = b(1-\omega^*)$ and $b'_{DS} = b(1+\delta)$. This implies $g(1) > 0$, which jointly with the continuity of g (Lemma 2) means that there exists a cutoff $\underline{\beta}(b)$ with $g(\beta) > 0$ for all β in $(\underline{\beta}(b), 1)$. ■

Equation (A.6) illustrates the trade-off between implementing debt relief with a standstill or with a write-off. On the one hand, the higher future debt that a standstill generates relative to a write-off leads the sovereign to incur more deadweight costs of defaulting. This depresses future consumption and is represented by the second term in equation (A.6). When the fall in the bond price does not compensate for the higher sovereign borrowing, a standstill may enable the sovereign to consume more in the short-run ($c_1^{DS}(b) > c(b(1-\omega^*))$). However, when the sovereign is sufficiently patient, the potential short-run benefit of the standstills is offset by the future higher cost. Our quantitative analysis suggests that write-offs are more effective than standstills for empirically plausible discount factors.

Two final remarks are in order. First, notice that the result in Proposition 5 does not hinge on the presence of a debt overhang problem. The key feature is that standstills lead to more future debt and a lower market value of debt. Second, there are no income effects, and the model is silent about shocks to period-1 income. However, we do not think this is a critical limitation. A negative income "shock" in period 1 would have a similar effect to a lower discount factor β, as both increase the value of current vs. future consumption.

We show next that write-offs also dominate standstills when both policies are introduced at a time when the government does not have access to debt markets. It is worth mentioning that the ability to issue debt after a write-off is less beneficial to the government in the two-period model than in the infinite-horizon model. Unlike in the infinite-horizon setup, in the two-period model, a write-off does not expand the borrowing set $q(b')b'$.

A.1 A two-period model with sudden stops

The setup is the same as the one studied before with the exception that we let the cost of defaulting to have $[0, \infty)$ as support. Since the borrower cannot issue debt in period 1, $b' = b$ and the continuation value after repaying is

$$V(b) = -\delta b - \beta[1 - F(b)]b - \beta \int_0^b \phi f(\phi) d\phi.$$

The equilibrium bond price is given by

$$q(b) = 1 - F(b).$$

The continuation value under repayment with a standstill satisfies

$$V^{DS}(b) = -\beta\left[1 - F(b(1+\delta))\right] b(1+\delta) - \beta \int_0^{b(1+\delta)} \phi f(\phi) d\phi,$$

and the bond price with a standstill satisfies

$$q^{DS}(b) = \left[1 - F(b(1+\delta))\right].$$

The next proposition shows that the government is better off and bondholders are worse off with a standstill.

Proposition 6 *$V^{DS}(b) > V(b)$ and $bq^{DS}(b)(1+\delta) < b[\delta + q(b)]$ $\forall b > 0$.*

Proof.

$$\begin{aligned} V(b) - V^{DS}(b) &= -\delta b - \beta[1 - F(b)]b - \beta \int_{-\infty}^{b} \phi f(\phi) d\phi + \beta\left[1 - F(b(1+\delta))\right] b(1+\delta) + \beta \int_{-\infty}^{b(1+\delta)} \phi f(\phi) d\phi \\ &= -\delta b - \beta[1 - F(b)]b + \beta\left[1 - F(b(1+\delta))\right] b(1+\delta) + \beta \int_{b}^{b(1+\delta)} \phi f(\phi) d\phi \\ &\leq -\delta b - \beta[1 - F(b)]b + \beta\left[1 - F(b(1+\delta))\right] b(1+\delta) + \beta\left[F(b(1+\delta)) - F(b)\right] b(1+\delta) \\ &\leq -\delta b - \beta F(b) b\delta + \beta b\delta \\ &\leq -\delta b[1 - \beta(1 - F(b))] < 0, \end{aligned}$$

where the inequality stems from replacing $\int_b^{b(1+\delta)} \phi f(\phi) d\phi$ with $\left[F(b(1+\delta)) - F(b)\right] b(1+\delta)$.

$$\begin{aligned} b[\delta + q(b)] - b(1+\delta)q^{DS}(b) &= b[\delta + 1 - F(b)] - b(1+\delta)\left[1 - F(b(1+\delta))\right] \\ &= b\left[F(b(1+\delta)) - F(b) + \delta F(b(1+\delta))\right] > 0. \end{aligned}$$

■

As in the model with borrowing, the borrower is better off with a standstill because it swaps a sure repayment in period 1 with a less-than-sure repayment in period 2 that is also discounted at the rate β. In the region where the government defaults with a standstill but repays without it, i.e., $\phi \in (b, b(1+\delta))$, the cost of defaulting is below $b(1+\delta)$. The value of debt claims at the beginning of period 1 declines with the standstill because the sure coupon payment δ is now exposed to default risk, and the higher debt carried to period 2 increases the default probability.

If the borrower receives a write-off that lowers its initial debt to $b(1-\omega)$, it is trivial to verify that $V(b(1-\omega)) > V(b)$. The effect on creditors' is less clear as $q(b(1-\omega)) > q(b)$. The following proposition establishes that it is possible to find a write-off that strictly Pareto dominates the standstill.

Proposition 7 *For any initial debt b, there is a $\underline{\beta}(b)$ such that for all $\beta \in \left[\underline{\beta}(b), 1\right]$, there exists a write-off that both the borrower and bondholders prefer over the standstill: $\forall b > 0$, there is a $\omega^* \in (0,1)$ such that $V(b(1-\omega^*)) > V^{DS}(b)$ and $b[\delta + q(b(1-\omega^*))] > b(1+\delta)q^{DS}(b)$.*

Proof. Let $\underline{b}$ denote the lowest debt b such that $\underline{b}(\delta + q(\underline{b})) = b(1+\delta)q^{DS}(b)$. It is easy to verify that $\underline{b} < b$. We will show there is a range of discount factors at which the borrower is strictly better off with $\underline{b}$ than with a standstill.

$$
\begin{aligned}
V(\underline{b}) - V^{DS}(b) &= -\delta\underline{b} - \beta[1 - F(\underline{b})]\underline{b} - \beta\int_{-\infty}^{\underline{b}} \phi f(\phi)d\phi + \beta\underbrace{\left[1 - F(b(1+\delta))\right] b(1+\delta)}_{=\underline{b}(\delta+q(\underline{b}))} + \beta\int_{-\infty}^{b(1+\delta)} \phi f(\phi)d\phi \\
&= -\delta\underline{b} - \beta[1 - F(\underline{b})]\underline{b} + \beta\underline{b}\left[\delta + 1 - F(\underline{b})\right] + \beta\int_{\underline{b}}^{b(1+\delta)} \phi f(\phi)d\phi \\
&= \delta\underline{b}(\beta - 1) + \beta\int_{\underline{b}}^{b(1+\delta)} \phi f(\phi)d\phi. \qquad \text{(A.7)}
\end{aligned}
$$

The expression in equation (A.7) is continuous, strictly increasing in β, takes a negative value at $\beta = 0$, and a strictly positive value at $\beta = 1$. Thus, there exists $\underline{\beta}(b) \in (0,1)$ such that $V(\underline{b}) \geq V^S(b)$ for $\beta \in [\underline{\beta}(b), 1]$. Notice that $q(b)b$ strictly increases at $b = \underline{b}$, and the continuity of V and $q(b)b$ implies that there exists a $b(1-\omega^*) > \underline{b}$ with the properties stated in the proposition. ■

Clearly, if $\beta = 0$, there is no debt relief (other than with a write-off of 100 percent) that is better for the borrower than a delay in debt payments. However, for a high enough borrower's discount factor, it is possible to find write-offs that the borrower prefers over a standstill. This is the case because the write-off lowers the default probability and thus the deadweight cost of defaulting. At the same time, for bondholders, this lower default probability compensates the reduction in the face value of debt thus the debt value implied by the write-off in higher than the one implied by the standstill.

This result illustrates a key advantage of write-offs over standstills as instruments of debt relief. While standstills increase debt levels and thus the default probability and the expected deadweight cost of defaulting, write-offs reduce indebtedness and thus the default probability and the expected deadweight cost of defaulting.