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Concessional credit lines for sovereigns in financial distress

This paper quantitatively assesses the macroeconomic effects of concessional credit lines for sovereigns in financial distress and shows how accessing credit lines could alleviate sovereign risk and contribute to macroeconomic stabilisation.

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In a world with high public debt and frequent external shocks, crisis prevention is less costly than crisis resolution, highlighting the importance of sovereign access to credit lines during financial distress. We assess the macroeconomic effects of concessional credit lines in a quantitative endogenous sovereign default model. The government can issue non-contingent long-term debt and access concessional credit lines from international financial institutions only during financial distress. These credit lines are long-term, non-defaultable, have grace periods and extended to countries with sound economic fundamentals. Our model, calibrated to Portugal, a representative small open economy in the euro area, shows that credit lines of 10% of GDP, if fully used when drawn, reduce sovereign spreads by 120 basis points and halve the default risk in response to exogenous shocks that increase the government's gross financing needs. Although credit lines improve household welfare by alleviating default concerns when first introduced, grace periods may slightly increase long-term debt and spreads if not combined with the enforcement of fiscal rules.

Keywords: Sovereign debt, default, credit lines, grace period, stigma premium
JEL codes: E44, F34

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Abstract

In a world with high public debt and frequent external shocks, crisis prevention is less costly than crisis resolution, highlighting the importance of sovereign access to credit lines during financial distress. We assess the macroeconomic effects of concessional credit lines in a quantitative endogenous sovereign default model. The government can issue non-contingent long-term debt and access concessional credit lines from international financial institutions only during financial distress. These credit lines are long-term, non-defaultable, have grace periods and extended to countries with sound economic fundamentals. Our model, calibrated to Portugal, a representative small open economy in the euro area, shows that credit lines of 10% of GDP, if fully used when drawn, reduce sovereign spreads by 120 basis points and halve the default risk in response to exogenous shocks that increase the government's gross financing needs. Although credit lines improve household welfare by alleviating default concerns when first introduced, grace periods may slightly increase long-term debt and spreads if not combined with the enforcement of fiscal rules.

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1 Introduction

The euro area has experienced a series of crises since 2010, starting with the sovereign debt crisis, followed by the pandemic and the war in Ukraine. Although the institutional financial architecture in the region has evolved significantly over these years, making it more resilient to external shocks, further strengthening of the safety net is essential to ensure the financial stability of the euro area. Following the post-pandemic fiscal stimulus and the war in Ukraine, euro area countries have, to different degrees, exhausted their fiscal room for maneuver, while still facing the future challenges of climate change, ageing and geopolitical tensions. Given the new framework for fiscal rules recently put in place, managing higher debt levels in the face of frequent external shocks is now at the centre of policy discussions (see World Bank (2022), IMF (2024), European Stability Mechanism (2024*a*)).

A key lesson from past crises is that preventing crises is less costly than resolving them. The European Stability Mechanism (ESM) addresses financial stability risks in the euro area through various instruments, including precautionary credit lines. These credit lines are designed to help countries with sound economic conditions maintain market access by strengthening economic credibility and preventing crises. Unlike the ESM's macroeconomic adjustment programmes, which are aimed at countries with significant financing needs that have lost access to markets, the credit lines are targeted at countries with fundamentally sound economies that are experiencing difficulties due to exogenous macroeconomic shocks rather than home-grown problems. These credit lines come with either no conditionality or light conditionality, similar to IMF credit lines (IMF (2023*a*), IMF (2023*b*))[1]. This paper focuses on the quantitative analysis of concessional credit lines from international financial institutions to financially distressed sovereigns with sound economic fundamentals. We consider credit lines that are cheaper than market rates and are fully utilised if tapped.[2]

We aim to contribute to the existing literature on sovereign risk by assessing the trade-offs in the use of credit lines within a quantitative sovereign default model. In

[1] https://www.esm.europa.eu/financial-assistance/lending-toolkit

[2] Several policy papers highlight the potential benefits of introducing a loan-based euro area stability fund (LSF) or similar variants (see Misch and Rey (2022)). The LSF facility would provide emergency loans with grace periods and lower interest rates than the market during crises, thereby helping to reduce the cost of borrowing for struggling economies. Proponents of credit lines argue that this instrument can enhance macro-financial stability by mitigating default risk, thus providing the government with the necessary fiscal space to implement countercyclical fiscal policies. Opponents, on the other hand, argue that credit lines can create incentives for governments to borrow more in times of stress, potentially leading to higher debt levels, unless fiscal rules are not sufficiently enforced.

particular, we address four main research questions: (i) how does access to credit lines affect sovereign borrowing costs during distress, (ii) to what extent do these facilities contribute to macroeconomic stabilisation, (iii) what are the benefits and costs of attaching grace periods to these credit lines, and (iv) how does the existence of such facilities affect sovereign borrowing in the long run?

To this end, we build a model of a small open economy that receives a stochastic income stream of a single tradable good. The government's objective is to maximise the expected utility of private agents. We follow Eaton and Gersovitz (1981) timing. Decisions are made sequentially: in each period, the government first determines whether to default on its non-contingent debt and then decides how much to borrow. A government in default incurs an income cost, is temporarily excluded from issuing non-contingent debt, and loses access to credit lines. Credit lines are available only during financial distress episodes when the government faces a shock that increases its gross financing needs. These credit lines include grace periods, during which payments are suspended for some periods, including in cases of default and exclusion. In later sections, we relax some of these assumptions to further explore the model's mechanisms.

Grace periods are a standard feature of multinational lending agreements (see International Monetary Fund (2024*a*), International Monetary Fund (2024*b*), European Stability Mechanism (2024*b*)) and have been included in proposals regarding the credit lines offered by the ESM (see Misch and Rey (2022)). Incorporating grace periods into economic models is important not only for their practical relevance but also for the potential insights they offer into debt dynamics. A key trade-off arises in attaching grace periods to loans drawn from credit lines. While they provide temporary relief during adverse income shocks, improving market completeness, they can also exacerbate the "debt dilution problem" in models of long-term debt. Debt dilution occurs when the issuance of new debt reduces the value of existing debt, potentially raising borrowing costs. We demonstrate that credit lines, if structured to remain continuously available exclusively during risk-on episodes, with no grace periods and short-term maturities, contribute to a decline in spreads over the long run. This approach allows credit lines to enhance market completeness without exacerbating the debt dilution problem.

We also find that prohibiting debt payment suspensions during default acts as a *disciplining device* for the government, yielding stronger quantitative effects. The intuition behind this is that if the government is required to meet its obligations from credit lines after default, the cost of defaulting becomes more pronounced. This, in turn, enables the government to sustain a higher level of non-contingent debt at lower spreads in equilibrium.

However, the government's ability to maintain higher debt levels when credit lines are in place may conflict with policymakers' preferences, a concern that has been publicly raised. Moreover, the significant increase in government indebtedness following large fiscal stimulus plans in the euro area has brought discussions of new fiscal rules to the forefront of policy debates. To address this issue and align with existing proposals, credit lines could be used as a financing tool to help sovereigns deleverage their debt to achieve the 60 percent debt-to-GDP ratio, a common policy goal aligned with the Maastricht rule.[3] We analyse a scenario in which the sovereign exchanges its defaultable debt with existing bondholders and uses credit line proceeds to finance this exchange using a net present value preserving (voluntary) debt exchange framework as in Hatchondo, Martinez and Sosa Padilla (2014). Our results show that such an exchange almost eliminates default risk and debt spreads, though it also increases consumption volatility, as debt brakes limit the government's ability to smooth adverse income shocks.

With debt reduction to sustainable levels becoming a key policy focus following significant fiscal stimulus across the euro area during the pandemic, credit lines, along with voluntary debt exchanges and debt brakes, can be instrumental in maintaining financial stability.

We calibrate our model to the Portuguese economy. We consider Portugal as an illustrative example for our policy exercise, since it is a representative small open economy in the euro area with strong economic and financial fundamentals but potentially susceptible to external shocks. Credit lines are calibrated to be capped at 10% of annual GDP, which is almost equal to the average annual gross financing needs of the country in recent years. Our findings suggest that in response to country-specific income shocks, credit lines of this size with a grace period of 10 years on average mitigate the widening of sovereign spreads by 120 basis points and halve the default risk upon their initial introduction. We also perform several counterfactual exercises with smaller credit lines and different numbers of grace periods as in Misch and Rey (2022).

A natural question arises: if credit lines are so beneficial, why haven't they been widely utilised despite being available for some time? We attribute this to a *stigma premium*, which is defined as the politically perceived cost of using credit lines (see Reinhart and Trebesch (2016) and European Stability Mechanism (2024*a*)). Our results suggest that the stigma premium for a credit line capped at 4% of annual GDP with a grace period of 3 years is around 9%. In other words, the politically perceived cost of using these credit lines would

[3] Debt brakes are institutional fiscal rules designed to limit government borrowing and ensure fiscal discipline. These rules, implemented in several countries—most notably Switzerland and Germany—are intended to constrain public debt levels and promote sustainable public finances.

have to reach 9% to explain their lack of use by countries. In addition, the stigma premium could reach 25% for credit lines with longer grace periods (capped at 10% of annual GDP with a grace period of 10 years). Without grace periods, we find that the stigma premium can reach up to 5%.

Related Literature. This paper contributes to the body of substantial research on quantitative sovereign debt including the works of Eaton and Gersovitz (1981), Aguiar and Gopinath (2006), and Arellano (2008). Influential studies, including Boz (2011), Fink and Scholl (2016), Hatchondo, Martinez and Önder (2017), and Önder (2022), have also examined credit lines within a quantitative default framework. We depart from this literature by introducing crucial contractual details, such as long-term maturities and grace periods associated with credit lines. By incorporating these features, we provide a unifying framework enabling a more comprehensive analysis of how specific contractual clauses in credit line programmes affect the pricing of standard loans in both the short and long term. This framework highlights credit lines' broader implications for consumption, debt dynamics, and overall welfare. Our findings propose that credit lines could yield long-run welfare gains if designed to be accessible only during risk-on episodes and structured as short-term instruments. While grace periods enhance market completeness, they exacerbate the debt-dilution problem, leading to higher sovereign spreads in the long run.

An important feature of our framework is the inclusion of long-term debt for both non-contingent debt and credit lines. Previous research emphasises the significance of long-term debt as a modeling choice for non-contingent contracts, as highlighted by Hatchondo and Martinez (2009), Chatterjee and Eyigungor (2012), and Arellano and Ramanarayanan (2012). Notably, Hatchondo, Martinez and Sosa Padilla (2016) demonstrate that debt dilution under long-term debt can significantly impact welfare, with its elimination potentially generating substantial welfare gains. Additionally, Aguiar et al. (2019) argue that, in the absence of income risk fluctuations, sovereigns should actively manage short-term debt while remaining passive with long-term debt. Our study departs from this literature by incorporating long-term credit lines as a distinct asset class. Unlike Aguiar et al. (2019), we show that when income risk fluctuations are considered, sovereigns actively manage long-term debt as well—engaging in activities such as buybacks or new issuance—highlighting the nuanced interaction between income risk and debt management strategies.

The literature on optimal sovereign debt contracts is extensive, encompassing works such as Atkeson (1991), Thomas and Worrall (1994), Kehoe and Perri (2003), Dovis (2018), and Callegari et al. (2023). Our study diverges from this body of work by incorporating strategic default risk into the analysis. Nonetheless, we argue that a contract design characterised by the absence of grace periods, short-term maturity, and availability limited to risk-on episodes can lower long-term borrowing costs by improving market completeness.

The rest of the article proceeds as follows. In Section 2, we describe the model environment, while in Section 3, we provide model results with a number of counterfactual. We conclude the article in Section 4.

2 The model

This section presents a dynamic small open economy model in which the government has the ability to issue non-contingent long-term debt and access to credit lines. The model assumes that the government lacks commitment to future decisions regarding default and borrowing. Consequently, this scenario can be interpreted as a game in which the government, making decisions in period t, acts as a player considering the strategies of other players (governments) who will make decisions after period t. The analysis focuses primarily on achieving a Markov-perfect equilibrium. In simple terms, this means that in each period, the government's default and borrowing strategies are determined only by payoff-relevant state variables.

In each period, the sequence of events unfolds as follows. First, the economy experiences the realisation of endowment, grace period, and local shocks. Subsequently, after observing these shocks, the government makes decisions about debt default and borrowing, subject to constraints influenced by its default choice.

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

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

with $|\rho| < 1$, and $\varepsilon_t \sim N\left(0, \sigma_\varepsilon^2\right)$.

Following Hatchondo et al. (2024), government expenditures denoted as e_t may take a low or a high value: $e_t \in \{e_L, e_H\}$, and it evolves according to a Markov process. During normal times, e_t equals e_L, while e_t becomes e_H during a local shock, with $e_H > e_L$. Specifically, a local shock ℓ initiates with probability $\pi_{LH}(y) \in [0,1]$ and concludes with probability $\pi_{HL} \in [0,1]$. To account for the correlation between negative conditions in international capital markets and low domestic aggregate income (Calvo, Izquierdo and Talvi, 2006*a*; Calvo, Izquierdo and Talvi, 2006*b*), we model π_{LH} as a decreasing function of y, expressed as $\pi_{LH}(y) = \min\left\{\pi_0 exp^{-\pi_1 \log(y) - 0.5\pi_1^2\sigma_\varepsilon^2}, 1\right\}$.

Access to credit lines is granted automatically during a local shock and expires when the shock is over.

Episodes of the grace period, denoted as $g \in \{g_S, g_N\}$, where g_S indicates being in a grace period and g_N indicates not being in one, follow a Markov process. In this process, a grace period begins with probability $\pi_{NS}(g) \in [0,1]$ and ends with probability $\pi_{SN} \in [0,1]$. If the government gains access to credit lines in the current period, then the probability of transitioning to a grace period in the following period is $\pi_{NS}(g' = g_S \mid e = e_H) = 1$. This is consistent with the stylised fact presented earlier. During suspended payment periods, creditors earn a rate of return r_C.

Preferences of the government over private consumption are 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.

Asset spaces: Two asset classes exist in the model. The first one is the standard long-term debt. As Hatchondo and Martinez (2009), we assume that a non-contingent bond issued in period t promises an infinite stream of coupons that decrease at a constant rate δ. In particular, a bond issued in period t promises to pay $\delta(1-\delta)^{j-1}$ units of the tradable good in period $t+j$, for all $j \geq 1$. Hence, non-contingent debt dynamics can be represented as follows:

$$b_{t+1} = (1-\delta)b_t + i_t,$$

where δb_t are the payments due in period t, and i_t is the number of non-contingent bonds issued in period t.

Similar to non-contingent debt, credit lines promise a continuous stream of coupons. These coupons represent periodic interest payments, and in this case, they decrease at a constant rate denoted by δ_C. Access to these lines is triggered when the sovereign faces a local shock ℓ and when the shock is over, the access expires. One key characteristic that sets these loans apart is the presence of grace periods. The repayment of loans under the credit line starts after a grace period. Grace periods refer to periods during which the borrower is not required to make repayments. This grace period starts after accessing to the credit lines and extends for a specified number of periods after the access expires. In particular, expectations are computed such that whenever the government accesses to a credit line, payments are suspended in the next period and then continues to be suspended for a stochastic number of periods.

If the sovereign has not defaulted and the payments of credit lines are suspended while the government has access to them, then the budget constraint reads

$$c = y - (e = e_H) - \kappa b + q(b', b'_C, y, p, g)\left[b' - b(1-\delta)\right] + q_C\left(b'_C - \frac{b_C}{1+r_C}\right),$$

where q and q_C denote the price of non-contingent bonds and credit line, respectively. Following the literature, we assumed credit lines to be non-defaultable and set the interest rate on them to equal to the risk free rate, $q_C = \frac{1}{1+r_C}$. Later on, we relax this assumption and introduce a premium. Note that the government expenditures e becomes e_H as the government can only access these credit lines when they are hit by local shocks. Next, $\kappa = \frac{r+\delta}{1+r}$ and $\kappa_C = \frac{r_C+\delta_C}{1+r_C}$ denote coupon payments of non-contingent debt and credit lines, respectively. If repayments on loans drawn from credit lines are within the grace period while the sovereign cannot access to credit lines, consumption is given by

$$c = y - (e = e_L) - \kappa b + q(b', b'_C, y, p, g)\left[b' - b(1-\delta)\right].$$

If the access to the credit lines is not triggered and the payments are not suspended, then the consumption is given by

$$c = y - (e = e_L) - \kappa b - \kappa_C b_C + q(b', b'_C, y, p, g)\left[b' - b(1-\delta)\right].$$

Lastly, if access to the credit lines is triggered and the payments that are due from its previous credit line balances are not in a grace period, then the consumption reads

$$c = y - (e = e_H) - \kappa b - \kappa_C b_C + q(b', b'_C, y, p, g)\left[b' - b(1-\delta)\right] + q_C\left(b'_C - (1-\delta)b_C\right).$$

Defaults. In the event of a government default, it encompasses both current and future debt obligations. This aligns with the observed behavior of defaulting governments and is a conventional assumption in the literature.[4] When a sovereign defaults, it is excluded from private debt markets for a stochastic period of time and faces an income cost of

[4] A notable aspect in sovereign debt contracts is the inclusion of an acceleration clause and a cross-default clause. The acceleration clause empowers creditors to demand immediate repayment if the government defaults on a debt payment. Simultaneously, the cross-default clause stipulates that any default in a government obligation triggers a default in the contract containing that clause. These clauses imply that following a default event, future debt obligations transition into the category of current obligations.

defaulting during its exclusion. Upon the government's re-entry, the government pays a fraction of its defaulted debt.

It is customary that the sovereign does not default on credit lines as they have a seniority over private debt and maintain their coupon payments as scheduled.

The budget constraint during defaults and exclusions is given by $c = y - e - \phi(y)$ if payments are suspended, and $c = y - e - \phi(y) - \kappa_C b_C$ if credit line payments are not suspended. The government does not have to make payments during exclusion if it overlaps with a grace period on the credit line contract.

2.1 Recursive Formulation

Let $s \equiv (y, \ell, g)$ denote the vector of exogenous states. Let V denote the value function of a government that is not currently in default. The function V satisfies the following functional equation:

$$V(b, b_C, s) = \max \left\{ V^R(b, b_C, s), V^D(b, b_C, s) \right\}, \tag{1}$$

where the government's value of repaying is given by

$$V^R(b, b_C, s) = \max_{b' \geq 0, b'_C \geq 0, c \geq 0} \left\{ u\left(c\right) + \beta \mathbb{E}_{(y'|y, \ell'|(y', \ell), g'|(\ell, g))} V(b', b'_C, s') \right\}, \tag{2}$$

subject to

$$\begin{aligned} c &= y - e - \kappa b - \left[1 - \mathcal{I}(g)\right] \kappa_C b_C + q(b', b'_C, s) i + \mathcal{I}(\ell) q_C i_C, \\ i &= b' - b(1 - \delta), \\ i_C &= b'_C - \left[1 - \mathcal{I}(g)\right] b_C (1 - \delta_C) - \mathcal{I}(g) b_C (1 + r_C), \\ b'_C &= \left(1 - \mathcal{I}\left(g\right)\right) b_C (1 - \delta_C) + \mathcal{I}(g) b_C (1 + r_C) \text{ if } \mathcal{I}(\ell) = 0, \\ q(b', b'_C, s) &\geq \underline{q} \; \forall \, b' > b(1 - \delta), \end{aligned} \tag{3}$$

where $\mathcal{I}(\ell)$ and $\mathcal{I}(g)$ are both indicator functions. $\mathcal{I}(\ell)$ becomes unity when the government is hit by a local shock and thus is allowed to borrow from multilateral institutions and equals 0 otherwise. Namely,

$$\mathcal{I}(\ell) = \begin{cases} 1 & \text{if } e = e_H, \\ 0 & \text{otherwise.} \end{cases}$$

$\mathcal{I}(g)$ activates during a grace period, indicating that payments are suspended, and becomes 0 otherwise. Equation (3) is the law of motion of credit lines when the sovereign cannot access them. Expectations, depicted in the right hand-side of equation (2), are computed such that whenever the government accesses credit lines, payments are suspended in the next period. That is, $\mathcal{I}(g') = 1$ if $\mathcal{I}(\ell) = 1$. When payments are suspended, it accrues interest at a rate r_C and the price of a credit line is given by a risk free rate $q_C = \frac{1}{1+r_C}$. The value of defaulting is given by:

$$\begin{aligned} V^D(b, b_C, s) &= u\left(y - e - \phi(y) - [1 - \mathcal{I}(g)]\,\kappa_C b_C\right) \\ &+ \beta \mathbb{E}_{s'|s}\left[(1-\psi)V^D(b, (1-\mathcal{I}(g'))(1-\kappa_C)b_C + \mathcal{I}(g')b_C, s')\right. \\ &+ \left.\psi V(\alpha b, (1-\mathcal{I}(g'))(1-\kappa_C)b_C + \mathcal{I}(g')b_C, s')\right], \end{aligned} \tag{4}$$

The solution to the government's problem yields decision rules for default $\hat{d}(b, b_C, s)$, non-contingent debt $\hat{b}(b, b_C, s)$, credit lines $\hat{b}_C(b, b_C, s)$, and consumption when not in default $\hat{c}(b, b_C, s)$. The default rule $\hat{d}$ is equal to 1 if the government defaults, and is equal to 0 otherwise. In a rational expectations equilibrium (defined below), investors use the borrowing and default decision rules to price debt contracts. Thus, the bond-price function solves the following functional equation:

$$\begin{aligned} q(b', b'_C, s) &= \mathbb{E}_{s'|s}\left[\exp^{-r}\left[\hat{d}\left(b', b'_C, s'\right) q^D(b', b'_C, s')\right.\right. \\ &+ \left.\left.\left[1 - \hat{d}\left(b', b'_C, s'\right)\right]\left[\kappa + (1-\delta)q\left(b'', b''_C, s'\right)\right]\right]\right] \end{aligned} \tag{5}$$

where

$$\begin{aligned} &q_d\left(b', b'_c, s\right) = \mathbb{E}_{s'|s}\left\{\exp^{-r}\left[\alpha\psi\left(\left(1-d'\right)\left[\kappa + (1-\delta)q\left(\hat{b}\left(\alpha b', \iota'_C, s'\right), \hat{b}_c\left(\alpha b', \iota'_C, s'\right), s'\right)\right]\right.\right.\right. \\ &\left.\left.\left.+ d' q_d(\alpha b', \iota'_C, s')\right) + (1-\psi)q_d\left(b', \iota'_C, s'\right)\right]\right\}, \end{aligned} \tag{6}$$

where $\iota'_C = (1 - \mathcal{I}(g))(1-\kappa_C)b'_C + \mathcal{I}(g)b'_C$, $d' = \hat{d}\left(\alpha b', \iota'_C, s'\right)$ denotes the next-period equilibrium default decision, $b'' = \hat{b}\left(b', b'_C, s'\right)$ denotes the next-period equilibrium non-contingent debt decision and $b''_C = \hat{b}_C\left(b', b'_C, s'\right)$ denotes the next-period equilibrium credit line decision.

2.2 Recursive Equilibrium

A *Markov Perfect Equilibrium* is characterised by

1. rules for default $\hat{d}$, non-contingent borrowing $\hat{b}$, and credit line borrowing $\hat{b}_C$
2. and bond price functions q and q_C for non-contingent and credit lines, respectively,

such that:

i. given the bond price functions q and q_C, the policy functions $\hat{d}$, $\hat{b}$, and $\hat{b}_C$ solve the Bellman equations (1), (2), and (4).

ii. given policy rules $\left\{\hat{d}, \hat{b}, \hat{b}_C\right\}$, the bond price function q satisfy condition (5).

2.3 Computation

Solving the model relies on iterating the value functions V^R and V^D, and price function q. To avoid the potential multiplicity problem outlined in Krusell and Smith (2003), we first solve the equilibrium of the finite-horizon economy. We start with an initial guess for the terminal value and iterate backward until the differences in value and price functions for two subsequent periods are less than 10^{-5}. We then use the obtained values as the equilibrium of the infinite horizon economy. We use 40 grid points for non-contingent debt, 40 grid points for credit lines, and 30 grid points for income. Expectations are computed using 300 Gauss-Legendre quadrature points.[5]

2.4 Calibration for the economy without credit lines

Table 1: Parameter values

	Parameter	Value	Target
Risk aversion	σ	2	Standard RBC value
Risk-free rate	r	4%	Standard RBC value
Discount factor	β	0.92	
Probability of reentry after default	ψ	1/3	Hatchondo et al. (2024)
Recovery rate	α	0.63	Cruces and Trebesch (2013)
Standard debt duration	δ	0.1	Average duration 6.7 years
Credit line duration	δ_C	0.1	Average duration of 10 years
Minimum bond price	$\underline{q}$	0.60	
Government consumption	$e = e_L$	0.12	Data
Credit line cap	$\overline{b_C}$	0.10	Average annual gross financing needs as a percent of GDP
	Calibrated		
Income autocorrelation coefficient	ρ_ϵ	0.78	Estimated
Standard deviation of innovations	σ_ϵ	2.54%	Estimated
Mean log endowment	μ	(-1/2)σ_ϵ^2	Normalisation
Income cost of defaulting	d_0	-1.13	Spread and debt-to-GDP ratio
Income cost of defaulting	d_1	1.288	Spread and debt-to-GDP ratio
Probability of entering local shock	π_0	0.38	3 high-financing needs episodes every twenty years
Probability of entering local shock	π_1	38	4% lower average income
Probability of grace period ending	π_{SN}	0.1	10 yrs of grace period
Local income shock	e_H	0.22	10% annual income loss

We first calibrate the benchmark model without credit lines ($i_C = 0$) to reflect key characteristics of the Portuguese economy. This economy is characterised by real debt that

[5]We use tools developed in Önder (2023) for the portfolio problem. In particular, we use bi-dimensional optimizers which are shown to be superior over taste shocks for portfolio problems.

cannot be inflated away, underpinned by strong fundamentals, yet stands to benefit from credit lines during periods of heightened local gross financing needs.

The utility function assumes a constant coefficient of relative risk aversion, given by:

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

The income cost of defaulting is defined as $\phi(y) = d_0 y + d_1 y^2$. This quadratic income cost structure allows us to match the average levels of debt and sovereign spreads observed in the data.

Table 1 presents the benchmark values assigned to all model parameters. Each period in the model represents one year. The risk-free interest rate is set at 4 percent, and the discount factor β is set at 0.92, both standard values in quantitative studies on sovereign defaults and business cycles in small open economies. We set $\underline{q} = 0.60$, which prevents consumption booms prior to defaults and is never binding in the simulations.

Except for the spread data, we use data from 1995 to 2019. The spread data becomes available after 1999, following Portugal's accession to the euro area. The parameters governing the endowment process are chosen to replicate the behaviour of logged and linearly detrended GDP in Portugal during this period.

Public expenditure, e_L, is set at 12% of average income, which is within the range of public consumption to GDP in Portugal. We set $\delta = 0.1$, which, alongside the targeted sovereign spread, yields an average debt duration of 6.7 years in the simulations—consistent with the average duration of public debt in Portugal.[6]

We model the local shock as one that increases the government's gross financing needs, such as in the case of a natural disaster. This type of shock is primarily domestic, similar to the framework used in Hatchondo et al. (2024).

Formally, we assume that government expenditures e shock follows a Markov process with probabilities set as $\pi_0 = 0.38$, $\pi_1 = 0.38$, and $\pi_{HL} = 0.8$. The low expenditure level, $e_L = 0.12$, is consistent with the baseline calibration, while the high expenditure level, $e_H = 0.22$, represents a 10 percent increase in public spending relative to average income—comparable to the shocks reported by Bova et al. (2016).

We set the cap on credit line limits, $\overline{b_C}$, at 10%, which is roughly equal to the average annual gross financing needs of the country as a percentage of GDP in recent years, with an average grace period of 10 years ($\pi_{SN} = 0.1$), To align with recent credit line proposals

[6]We use data from the Public Debt Management Office of Portugal (https://www.igcp.pt/en/) for the average debt duration and apply the Macaulay definition of duration, which, given the coupon structure in this paper, is given by $D = \frac{1+r^*}{\delta+r^*}$, where r^* denotes the constant per-period yield delivered by the bond.

Table 2: Main Results: Long-run moments in different model economies

	(1) Data	(2) Baseline (No cred lines)	(3) Credit lines 10%, 10yrs	(4) Credit lines 4%, 3yrs
Mean public debt to GDP (%)	88.1	88.8	92.1	89.9
Mean credit lines to GDP (%)	*n.a.*	*n.a.*	8.3	3.4
Mean sovereign spread (r_s) (%)	1.8	1.8	1.9	1.8
Spread volatility ($\sigma(r_s)$)	2.9	0.8	0.8	0.8
$\sigma(c)/\sigma(y)$	1.1	1.5	1.5	1.5
$\rho(r_s, y)$	-0.5	-0.8	-0.8	-0.8
Defaults per 100 years	n.a.	4.0	4.4	4.1
Average duration of debt (in yrs)	6.6	6.7	6.6	6.6
Average grace period of credit lines (in yrs)	*n.a.*	*n.a.*	10	3
Spread rise during local shocks	1.5	1.6	1.8	1.6

The first column reports Portugal's data moments, the second column reports the results of the baseline model without credit lines and the third column presents the results with credit lines with a 10% cap and a 10-year grace period, while the last column shows the results with credit lines with a 4% cap and 3-year grace period. The standard deviation of a variable is denoted by σ, and the coefficient correlation between variables is denoted by ρ. Consumption and income are reported by natural logs.

(e.g., Misch and Rey (2022)), we revisit our analysis using a 4% cap on credit lines and a 3-year grace period.

To calibrate the model, we adjust two parameters for the cost of default, two parameters for the likelihood of entering a high-financing-need period, and the risk premium (d_0, d_1, π_0, π_1, and π_{HL}). These are calibrated to match five key moments: an average spread of 1.8 percent, a public debt-to-GDP ratio of 88.1 percent, three high-financing needs episodes per 20 years, a 4% trend-income reduction during these episodes (Calvo, Izquierdo and Talvi, 2006*b*) with a 1.5 percentage point increase in spreads during a local shock. The targets for debt and spread levels are again based on data from Portugal.

In our model, duration of credit line repayments are set to be 10 years, $\delta_C = 0.1$. Consistent with previous proposals, we assume that deferred payments accrue interest at the risk-free rate ($r_C = r$), meaning there is no nominal debt forgiveness associated with credit lines.

Table 2 reports moments in the data and in the simulations of the benchmark economy with non-contingent debt. Simulations match the moments targeted in the calibration well.

3 Results

We assess the impact of introducing credit lines by comparing simulation outcomes between a baseline economy without credit lines and one where the government can issue non-contingent bonds and access credit lines. Our findings suggest that, over the long run, the introduction of credit lines leads to an increase in total sovereign indebtedness, as well as a modest rise in default risk and interest rate spreads.

To analyse model dynamics, Figure 1 illustrates the impact of credit lines on bond prices. The upper panels show the government's equilibrium pricing schedule in economies with and without credit lines during normal times, when credit line utilisation is zero ($b_C = 0$). The dashed red line represents the economy with credit lines and the solid blue lines represent the baseline economy. The upper-left chart plots the equilibrium price functions as a function of income when debt is fixed at the ergodic level of the benchmark economy, specifically $b = 88.8\%$ for both the baseline and for the economy with credit lines. The upper-right chart displays pricing schedules with income set at 2.5 standard deviations below trend and plots it as a function of non-contingent debt. In the upper-left panel, asset prices are higher in the economy with credit lines, as the lower probability of default for a given income and debt level reduces interest rates (since bond prices and interest rates are inversely related). Similarly, in the upper-right panel, prices in the economy with credit lines remain higher because the risk of default is lower, even with long-term debt, due to future default probabilities.

The lower panel of Figure 1 provides further insights into price and model dynamics. The top-left chart depicts equilibrium prices as a function of income, with non-contingent debt and credit line levels fixed at their respective long-run values (88.8% for the baseline and 92.1% non-contingent debt) and zero credit line utilisation. In contrast, the top-right chart illustrates equilibrium prices as a function of non-contingent debt, assuming income is 2.5 standard deviations below its long-run trend and credit line utilisation remains at zero. These charts reveal that asset prices improve when credit lines are accessed but unused. The bottom charts replicate these analyses, this time setting credit line utilisation to its ergodic value ($b_C = 8.3\%$). They show that asset prices are slightly lower in an economy with credit lines, though this difference is subtle due to scaling. This finding aligns with the mean sovereign spread (r_s) reported in Table 2.

3.1 Transition Dynamics

In this section, we analyse an unanticipated announcement such that the government would have access to credit lines from now on during a local shock. This way, we can explore how long it takes for the credit line economy to reach its long-run average and better understand the dynamics of the model.

Specifically, the constraints on the amount of debt a government can borrow through credit lines change from 0 to 0.10 when $\ell = e_H$. Figure 2 shows the impulse response functions (IRFs) for a 2.5 standard deviation income shock in an economy facing a local shock. The top left-hand corner shows the path of the income shock fed to the model.

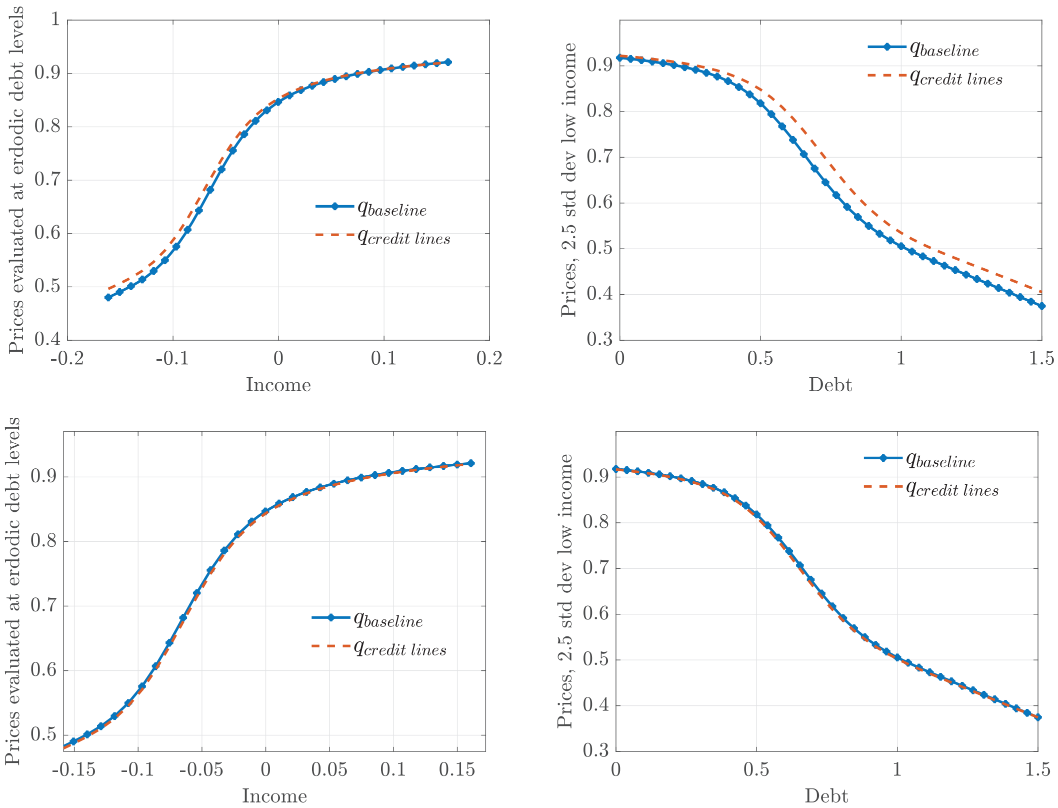

Figure 1: Equilibrium prices. The upper panels display the equilibrium price functions during normal times, when credit line utilisation is zero ($b_C = 0$)). The upper left panel shows equilibrium prices as a function of income, while the upper right panel shows them as a function of debt. The bottom left panel illustrates the economies at their ergodic levels, with 88.8% non-contingent debt for the baseline case and 92.1% non-contingent debt for the economy with a 10% credit line. The bottom right panel replicates the upper right panel, but now b_C is set to 10 percent of mean income, which is normalised to unity.

The red dashed lines represent the benchmark economy, while the yellow dashed lines represent the economy with unanticipated credit lines.

The figure shows that after the income shock, the benchmark economy slightly increases its indebtedness. The government would have preferred borrowing more to smooth consumption if it were not constrained by default risk. As the probability of default increases, the cost of borrowing, as measured by spreads, rises sharply, limiting the government's ability to smooth consumption through borrowing. In contrast, at the time of introduction, credit lines reduce default risk, leads a significant decline in consumption volatility, allowing for cheaper borrowing than in the economy without credit lines, consistent with the equilibrium price dynamics shown in Figure 1. Having access to a new source of funding in times of stress is key to avoiding significant borrowing costs and default. This incentivises the government to borrow more, leading to a higher stock of non-contingent debt in the long run, with a slightly higher spread and default risk.

The economy with credit lines taps them immediately upon access, leading to an initial short-term surge in consumption. In the long run, however, higher borrowing costs and interest payments take their toll, resulting in lower consumption than in the baseline scenario. This raises the question of whether credit lines really improve welfare, which we explore in the next section.

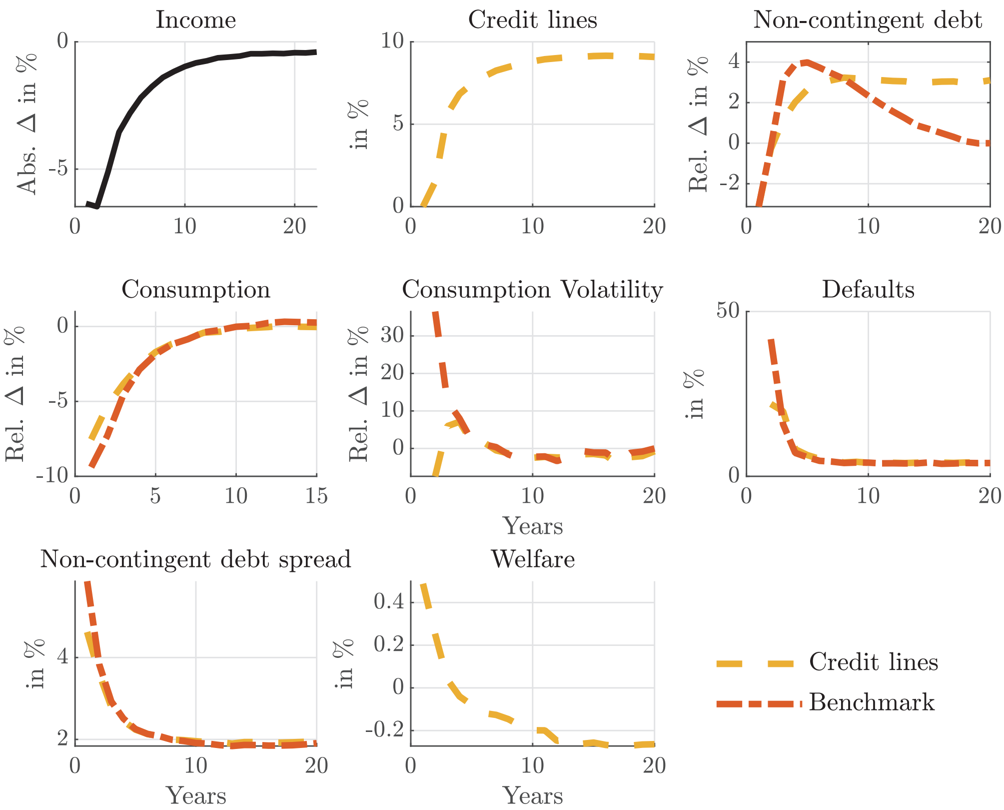

Figure 2: Impulse Response Functions. The figure illustrates the behaviour of key variables following a simultaneous shock to each economy, which starts with an initial average debt level (as in the baseline economy) and is jointly affected by a local shock and a negative income shock of two-and-a-half standard deviations. The local shock lasts for one year, while the income shock follows its recovery path, as depicted in the upper left chart. Credit lines, defaults, spreads, and welfare are shown in levels, while other variables are expressed as percentage deviations from the baseline. The dashed yellow line represents the economy with credit lines and the red dashed-dotted line corresponds to the benchmark.

3.2 Welfare analysis

In this section, we examine whether switching to an economy with credit lines is welfare enhancing. We measure the welfare gain from the introduction of credit lines as the constant proportional change in consumption that would make a consumer indifferent between living in the economy without credit lines and living in the economy with credit lines. These welfare gains are given by

$$\left[\frac{\hat{V}^{\text{NC}}(b,y,s)}{\hat{V}^{\text{credit}}(b,0,s)}\right]^{\left(\frac{1}{1-\gamma}\right)} - 1,$$

where the super-index "NC" refers to the value function in the benchmark economy and the super-index "credit" refers to the economy with credit lines. Thus, a positive welfare gain means that agents prefer the economy with credit lines.

The left panel of Figure 3 plots the welfare gains as a function of the calibration target for the baseline economy (which is 88.8% and alternative income levels) from switching to the economy with credit lines for two cases: the dashed red line is when the economy faces a local shock, while the solid blue line represents normal times. The figure shows that the gains can be substantial. The consumption panel of Figure 2 shows that when credit lines are introduced, the government taps these credit lines, which leads to a front-loading of consumption. And in the long run, as higher borrowing takes its toll, welfare closely follows the path of consumption and the economy with credit lines ends up with a welfare loss.

Turning to Figure 3, we observe lower welfare gains for increasing income levels as the probability of default decreases, which reduces the price differentials between credit lines and baseline economies. These price differentials are also visually apparent in the panels of Figure 1. The discontinuity in welfare gains arises because the government defaults below a certain income threshold for a given portfolio allocation and state.

The right panel of the figure highlights the source of welfare gains for the mean level of output as a function of the ratio of net debt issuance $(b' - b(1-\delta) + b'_C)$ to mean income (normalised to one) at the time of credit line introduction. Thick dots reflect equilibrium realisations. These graphs are consistent with Figure 1. In particular, the thick dots on these price graphs show that the economy with credit lines issues higher amounts of debt at a lower price, which leads to an increase in consumption and thus an increase in welfare gains.

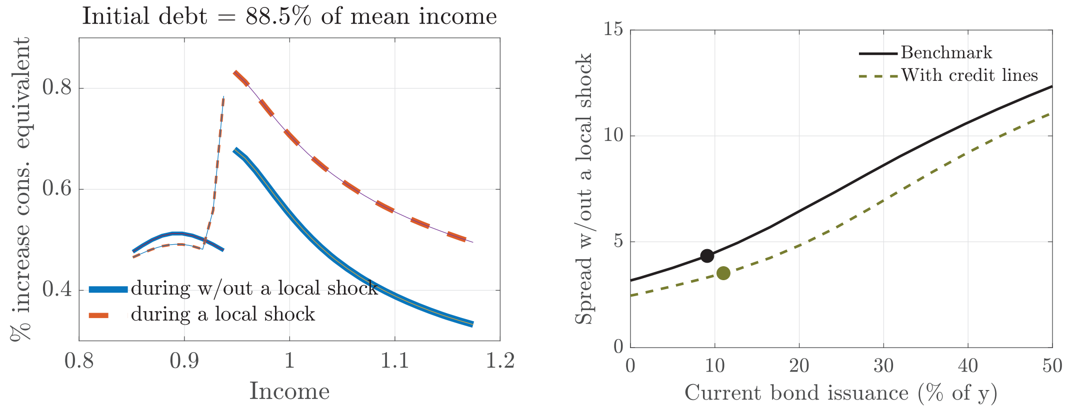

Figure 3: Welfare gains from switching to the economy with credit lines. The left panel illustrates the welfare gains, expressed in consumption equivalent terms, resulting from transitioning from the baseline economy to the economy with credit lines. At the time of the switch, the initial debt portfolio includes no credit lines ($b_C = 0$) and a stock of non-contingent debt that represents long-term indebtedness in the baseline economy. The right panel compares the impact of this switch on the debt pricing schedule, depicting the relationship between the ratio of net debt issuance ($b' - b(1-\delta) + b'_C$) and mean income (normalized to one) at the time of the switch. Thick dots indicate equilibrium realisations.

3.3 Role of grace periods

In this section, we explore the role of grace periods, a key feature of nearly all proposed credit line frameworks. Recall that in our baseline credit line economy, once accessed, the credit line involves a 10-year suspension period. The probability of accessing the credit line is tightly tied to the adverse developments of income shocks. In column 2 of Table 3, we set the grace period to three years, during which the severity of the income shock subsides, aligning with the recent credit line proposals (see Misch and Rey (2022)), which is typically around three years. In the last column, we remove grace periods entirely. Several key observations arise from these variations. First, shorter grace periods are associated with higher non-contingent debt-to-GDP ratios and reduced reliance on credit lines. This is because shorter grace periods facilitate better market completion. A 3-year grace period is particularly effective, as the sovereign is likely to recover from an adverse shock within that time frame, whereas a 10-year grace period risks coinciding with a new business cycle, potentially leading to another recession. Thus, if the government faces a new fiscal shock within the 10-year period, it may have already exhausted its available credit line resources.

Another mechanism relates to the anticipated changes in default costs. As shown in equation (4), sovereign payments can be suspended during periods of default. For instance, if a credit line is accessed in period 1 with a 10-year grace period and the sovereign defaults in period 2, the grace period continues for the remaining 8 periods.

Since sovereigns are typically excluded from credit markets for an average of three years following a default, they may not be required to make any payments during the exclusion period. Consequently, shortening the grace period also serves as a *disciplining device*. The results in the third column indicate that the disciplining effect of shorter grace periods is more pronounced than their impact on market completion. We further investigate the disciplining device channel in Section 3.6.2. In the fourth column, we drop grace periods as in column 3, but now assume that credit lines are one-period. As a result, credit lines are short-term contracts and only available when the gross financing needs of a government jump. In that regard, it closely resembles the construction of swap lines. The results provide important insights about credit lines. When credit lines are long-term and non-defaultable, they exacerbate the debt-dilution problem inherent in long-term debt models. The mean credit lines-to-GDP ratio is lower under the fourth column because credit lines are one-period and available only when the government's gross financing needs surge. In contrast, in other columns, credit lines are long-term and decay at a rate of δ_C.

Table 3: Role of grace periods

	(1) Baseline credit lines	(2) 3 years grace period	(3) No grace period	(4) No grace one period
Mean public debt to GDP (%)	92.1	94.8	93.9	88.6
Mean credit lines to GDP (%)	8.3	5.5	5.4	1.2
Mean sovereign spread (r_s) (%)	1.9	1.9	1.7	1.3
Spread volatility ($\sigma(r_s)$)	0.8	0.8	0.7	0.5
$\sigma(c)/\sigma(y)$	1.5	1.5	1.5	1.5
$\rho(r_s, y)$	-0.8	-0.8	-0.9	-0.9
Defaults per 100 years	4.4	4.4	4.1	4.8
Avg duration of debt (in yrs)	6.6	6.6	6.7	6.8
Avg grace period of credit lines	10	3	0	0
Spread rise during local shocks	1.8	1.6	1.3	1.0

The first column presents the results of the baseline model with credit lines, the second column reports the results for the economy with a three-year grace period for credit lines, and the third column shows the outcomes when grace periods are removed from the model while the last columns shows the results with grace periods are removed and the credit lines are set to be one-period ($\delta_C = 1$). The standard deviation of a variable is denoted by σ, and the correlation coefficient between variables is denoted by ρ. Both consumption and income are reported in natural logarithms.

Figure 4 plots the IRF of introducing credit lines with no grace period denoted by "No grace period" in the figure. Both credit line economies display similar dynamics in the very short run. In summary, both economies immediately tap the credit lines to stave off default and initially rely on credit line financing, which leads consumption front-loading and lower borrowing costs during a local shock when credit lines are first introduced.

The key differences, however, emerge in the long run. The economy with no grace period chooses lower credit line utilisation. Interestingly, this increases the sovereign's precautionary motives of saving on credit lines to use it during more adverse economic shocks. Yet, this implied increase in the default cost allows the sovereign to sustain higher non-contingent debt accumulation in equilibrium. This, in turn, leads to higher interest payments on debt and, eventually, slightly lower consumption levels. Since welfare closely tracks consumption, long-term welfare in the economy with the no grace period is similar to the credit line economy with 10 years of grace period.

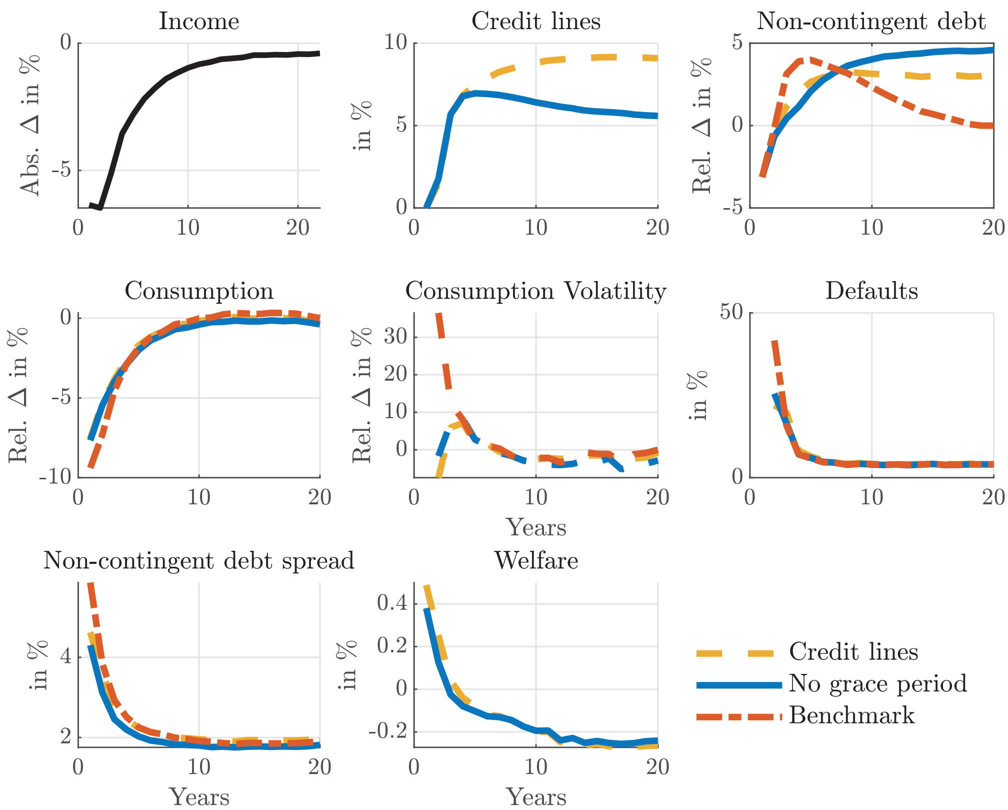

Figure 4: Impulse Response Functions. The figure illustrates the behaviour of key variables following a simultaneous shock to each economy, which starts with an initial average debt level (as in the baseline economy) and is jointly affected by a local shock and a negative income shock of two-and-a-half standard deviations. The local shock lasts for one year, while the income shock follows its recovery path, as depicted in the upper left chart. Credit lines, defaults, spreads, and welfare are shown in levels, while other variables are expressed as percentage deviations from the baseline. The blue solid line represents the case where the grace period is absent, while the dashed yellow line represents the economy with credit lines and a 10-year grace period. The red dashed-dotted line corresponds to the benchmark.

3.4 Net present value preserving (voluntary) debt exchange

In this section, we examine the impact of introducing credit lines through a debt exchange, where the government negotiates concessions from bondholders as in Hatchondo, Martinez and Sosa Padilla (2014). Bondholders are not disadvantaged by this exchange, as they benefit from capital gains due to both the reduction in non-contingent debt and the introduction of credit lines. Following the framework of Hatchondo, Martinez and Önder (2017), we describe such a debt exchange as "voluntary" because it does not impose direct losses on bondholders. However, it is important to note that this notion of a voluntary exchange should not imply that each creditor's participation is entirely voluntary. While the exchange may be collectively beneficial for creditors, individual bondholders might prefer to free-ride on the participation of others, choosing not to participate. The challenges of collective action have already been recognised, and these challenges in the context of sovereign debt arise when multiple creditors need to coordinate their actions with respect to the exchange of a country's debt. Sovereign debt restructuring usually involves multiple creditors, including bondholders, private lenders, and international institutions. Without a central authority to coordinate, individual creditors might hold out for better terms, which can delay or complicate the process. In practice, determining the degree of government pressure on bondholders to participate in such exchanges can be difficult. By focusing on voluntary debt exchanges, we explore the ideal scenario in which the government captures the full value of bondholders' capital gains resulting from the arrangement of credit lines. As noted in Hatchondo, Martinez and Önder (2017), voluntary debt exchanges are prominent in policy discussions (Claessens and Dell'Ariccia (2011)) and are frequently observed in practice (Hatchondo, Martinez and Sosa Padilla (2014)).

Assume that at the beginning of the period when credit lines are introduced, the government offers bondholders a take-it-or-leave-it proposal. For each non-contingent debt coupon payment due during this period, bondholders would receive a deferred payment of $\frac{\overline{b_C}}{b}$, to be paid in the following period, along with a portion of non-contingent bonds worth b_V/b, which start paying coupons immediately. If the bondholders reject this offer, credit lines will not be introduced.

The government determines the level of non-contingent debt, denoted by b_V, such that bondholders, as a group, are indifferent between accepting or rejecting the offer. This allows the government to capture all the benefits of introducing credit lines. The post-exchange quantity of non-contingent bonds, b_V, satisfies the following condition:

$$
\begin{aligned}
\frac{\overline{b_C}}{b(1+r)} &+ \frac{b_V(b,\overline{b_C},s)[\kappa+(1-\delta)q((1-\delta)b_V(b,\overline{b_C},s),\overline{b_C},s)]}{b} \\
&= \kappa+(1-\delta)q_N(\hat{b}_N(b,s),s),
\end{aligned} \tag{7}
$$

where q_N and $\hat{b}_N$ represent the bond price and the government's borrowing function, respectively, in an economy without credit lines (i.e., where $\overline{b_C}=0$, so $\overline{b_C}$ is not needed as a state variable).

The right-hand side of the equation reflects the value a bondholder would receive if they reject the exchange, incorporating both current period payments and future obligations. The left-hand side represents the value a bondholder would receive if they accept the exchange, accounting for the deferred payments and the newly issued non-contingent bonds.

Figure 5 illustrates gains from arranging credit lines through a voluntary debt exchange, as a function of income, based on the average non-contingent debt level of 88.8% observed in the benchmark economy. The upper-left panel shows how much non-contingent debt can be exchanged with bondholders solely due to the price effect triggered by the announcement of credit lines, even if the government does not utilise them (i.e., setting $\overline{b_C}=0$ in equation (7)). The amount of debt eligible for exchange is substantial at lower income levels, as these periods correspond to heightened default risk. Credit lines help mitigate these risks, resulting in significant price differentials between an economy with and without credit lines. The bottom left chart plots the corresponding welfare gains measured in consumption equivalent terms from switching to the economy with credit lines through voluntary debt exchange.

The right panels of Figure 5 show how much non-contingent debt can be exchanged under a credit line limit of 10%, along with the corresponding welfare gains from such an arrangement. A key takeaway from this analysis is that with a 10% credit line limit, the government can exchange significant amounts of non-contingent debt by leveraging capital gains from asset price improvements. However, voluntary debt exchanges have no long-term effects. Therefore, credit lines can be viewed as a financial tool to reduce long-term sovereign indebtedness. This suggests that credit lines could be arranged with certain conditions, which will be explored in the next subsection.

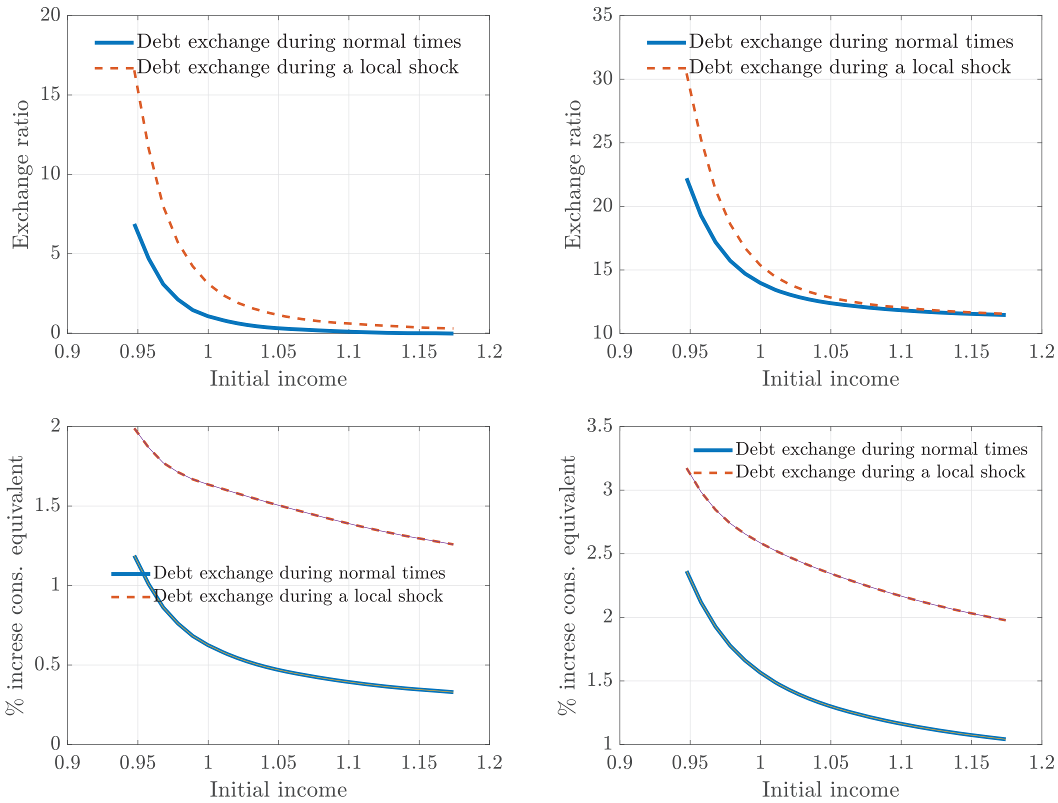

Figure 5: Voluntary Debt Exchanges

3.5 Voluntary debt exchanges with a debt break for non-contingent debt

Fiscal rules, such as debt brakes, are institutionalised constraints on government fiscal policies, aimed at maintaining sustainable public finances over time. Debt brakes are a specific type of fiscal rule designed to prevent excessive government borrowing and ensure that public debt remains manageable (see Kopits and Symansky (1998) for fiscal rules). The debt brake is a rule designed to limit the amount of debt that a government can take on. It was pioneered by Switzerland and has been adopted or modified by several other countries, such as Germany, to regulate government borrowing and enforce fiscal discipline (see Hofmann (2022)).

Switzerland's debt brake, introduced in 2003, mandates that over the economic cycle, federal expenditures cannot exceed revenues. The rule is embedded in the Swiss constitution and is credited with maintaining balanced budgets and low debt-to-GDP ratios. Germany's "Schuldenbremse" (debt brake) was introduced in 2009.

Debt brakes are a powerful fiscal rule that can promote sustainable public finances by limiting government borrowing. When designed with appropriate flexibility and enforcement mechanisms, they can help prevent fiscal crises and ensure economic stability. Credit lines can thus be viewed as a financing tool to attain more sustainable debt levels.

As previously discussed, while the introduction of credit line may offer only short-term benefits, such financial instruments can be pivotal in supporting the transition toward achieving fiscal targets mandated by debt brakes, potentially resulting in more lasting positive effects. The complementarities between credit lines and fiscal rules have been recognised for some time (see Hatchondo, Martinez and Roch (2022), Hatchondo, Martinez and Önder (2017), Önder (2022)).

In this analysis, we explore the effects of introducing credit lines in conjunction with a debt brake that imposes limits on non-contingent debt. Specifically, we assume that non-defaultable bonds, equating to 10% of mean income (normalised to one), are issued to facilitate a voluntary debt restructuring. At the same time, we implement an immediate cap on defaultable debt at 60% of mean income which is normalised to one. This threshold is selected for two key reasons: (i) the credit lines provide sufficient financing to support the necessary debt reduction to implement this cap, and (ii) the cap substantially lowers the likelihood of default.

Figure 6 presents the IRFs following the introduction of credit lines, subsequent to the voluntary debt exchange undertaken with bondholders. The charts depicting credit lines and non-contingent debt reflect the outcomes of this exchange. The entirety of the credit lines was allocated to finance the debt exchange, thereby reducing the government's non-contingent debt in compliance with the prescribed 60% debt threshold. Immediately after the exchange, both default risk and debt spreads decline sharply. In contrast to the scenario without debt exchange, as indicated by the yellow dashed line, the economy featuring voluntary exchanges and debt breaks exhibits higher immediate and long-term welfare, as well as increased consumption upon impact. However, one notable drawback of the debt break mechanism, which has also been highlighted in policy discussions, is that stringent debt break rules constrain the government's capacity to smooth consumption during adverse economic conditions. This is evident from the consumption volatility chart, which shows that consumption volatility remains elevated relative to the baseline scenario.

Thus, our findings highlight a trade-off. Debt brakes, when paired with credit lines and voluntary debt exchanges to achieve targeted debt levels, foster fiscal discipline by reducing the likelihood of default crises. However, while debt brakes are effective at maintaining fiscal responsibility, they are also criticised for their rigidity, which can inhibit the necessary fiscal expansion during economic downturns.

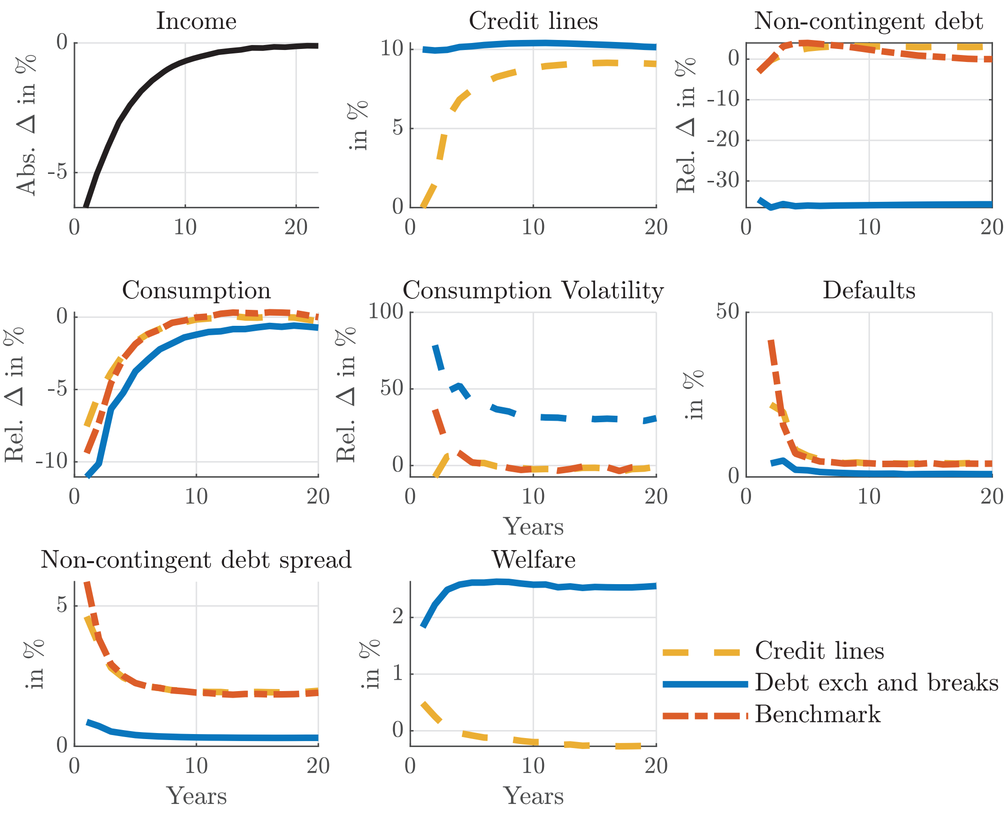

Figure 6: Impulse Response Functions. The figure illustrates the behaviour of key variables following a simultaneous shock to each economy, which starts with an initial average debt level (as in the baseline economy) and is jointly affected by a local shock and a negative income shock of two-and-a-half standard deviations. The local shock lasts for one year, while the income shock follows its recovery path, as depicted in the upper left chart. Credit lines, non-contingent debt, defaults, spreads, and welfare are shown in levels, while other variables are expressed as percentage deviations from the baseline. The blue solid line represents the economy where voluntary debt exchanges occur, with the sovereign adhering to a 60% debt brake rule. In contrast, the dashed yellow line represents the economy with credit lines and a 10-year grace period. The red dashed-dotted line corresponds to the benchmark.

3.6 Investigating Model Mechanism

3.6.1 Permanent credit lines

This section presents the quantitative analysis of an economy in which credit lines are permanently available, rather than only during local shocks. The model is solved using one-period credit lines, which distinguishes the contribution of this paper from the existing literature. In particular, we introduce credit lines to be available permanently, as in Hatchondo, Martinez and Önder (2017), including periods of default, and emphasise the importance of a trigger mechanism in the contract. Specifically, we set $\mathcal{I}(\ell) = 1$ at all times, with $\delta_C = 1$. The results of this analysis are presented in the second column of the Table 4, with the first column showing the baseline economy for reference. Our results indicate that, consistent with Hatchondo, Martinez and Önder (2017), credit lines have no long-run effects.[7]

Next, we eliminate the grace period feature of credit lines while retaining their long-term debt characteristics. Consequently, we revisit the analysis from Hatchondo, Martinez and Önder (2017), now incorporating long-term credit lines. The results are presented in the third column of Table 4. Allowing long-term credit lines to be continuously available does not significantly affect the long-run moments compared to their one-period counterpart. With such loans, the government only needs to roll over the coupon payments, $b_C\kappa_C$, whereas with one-period credit lines, it must roll over the full principal, b_C. Since long-term loans can be rolled over indefinitely, no significant differences emerge.

Next, we eliminate the grace period feature of the credit lines while maintaining their long-term debt characteristics. As a result, we re-conduct the analysis from Hatchondo, Martinez and Önder (2017), but now with long-term credit lines. The results are presented in the third column of Table 4. The use of long-term credit lines, when available all the time, does not change long-run moments meaningfully compared to its one-period correspondent. With long-term credit lines, the government only has to roll over its coupon payments, i.e., $b_C\kappa_C$, whereas, with one-period credit lines, it has to roll over the full amount b_C. As the sovereign can roll over them indefinitely, we do not observe meaningful differences.

3.6.2 Pay all credit lines if defaulted

In this subsection, we examine a counterfactual scenario where the sovereign repays the full credit line obligations upon defaulting on its debt. Specifically, the budget constraint during default becomes $y - e - \phi(y) - b_C$, and, upon reentry into the credit markets, the sovereign starts with no outstanding credit lines.

The results are presented in the fourth column of Table 4. Notably, while the government's long-run public debt-to-GDP ratio increases by 14 percentage points, interest rate spreads decrease by nearly one-fifth, and default rates fall. This is because the seniority of credit lines and the requirement to repay them in full serve as a *disciplining device*, increasing the cost of default for the sovereign.

[7]We omit IRFs for brevity, as they closely mirror those in Hatchondo, Martinez and Önder (2017). In essence, the government utilises these funds to avert default upon introduction, but subsequently continues to roll over the debt indefinitely, rendering the credit lines akin to a free lunch.

Table 4: Model mechanism

	(1) Baseline	(2) Perm. lines one-period	(3) Perm. lines long-term	(4) Pay all if default	(5) Stigma (p=0.25)	(6) Stigma no grace (p=0.05)
Mean public debt to GDP (%)	88.8	87.6	88.0	102.9	89.6	89.6
Mean credit lines to GDP (%)	*n.a.*	8.6	8.1	8.6	1.4	0.5
Mean sovereign spread (r_s) (%)	1.8	1.8	1.8	1.5	1.8	1.7
Spread volatility ($\sigma(r_s)$)	0.8	0.8	0.8	0.7	0.8	0.8
$\sigma(c)/\sigma(y)$	1.5	1.7	1.5	1.5	1.5	1.5
$\rho(r_s, y)$	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
Defaults per 100 years	4.0	4.0	4.1	3.7	4.0	4.0
Avg duration of debt (in yrs)	6.7	6.7	6.7	6.8	6.7	6.7
Avg grace period of credit lines	*n.a.*	0	0	10	10	0
Spread rise during local shocks	1.6	1.4	1.4	1.3	1.6	1.5

The first column presents the results of the baseline model. The second column reports the results for an economy with no grace periods, where credit lines are available at all times, including during defaults, with a duration of one period, i.e., $\delta_c = 1$. The third column shows the results from the second column but with long-term credit lines, where $\delta_c = 0.1$. The fourth column displays the results when the sovereign is required to fully repay its credit line obligations upon default. The fifth column presents the results under a stigma premium of $p = 0.25$, while the final column shows the outcomes with a stigma premium of $p = 0.05$ and no grace periods. The standard deviation of a variable is denoted by σ, and the correlation coefficient between variables is denoted by ρ. Both consumption and income are reported in natural logarithms.

3.6.3 Stigma premium

An obvious question is why credit lines, despite their clear benefits and long-standing availability, have not been widely adopted. We attribute this to a political *stigma premium* (European Stability Mechanism, 2024*a*). The stigma premium on loans from financial institutions refers to the additional costs or challenges that countries may encounter when seeking financial assistance from such entities due to associated reputational or political risks and negative perceptions. It has been long established that for many countries, IMF loans are seen as a measure of last resort, and borrowing from the IMF can carry a significant social and economic stigma. This perception can result in elevated costs for the borrowing country, both directly and indirectly, beyond the standard interest rate or repayment terms (see Reinhart and Trebesch (2016)).

Next, in the spirit of Moretti (2020) and Hatchondo et al. (2024) we measure the effects of assuming that credit lines carry a stigma premium over the advertised rate, given by $q_c = \frac{1}{1+r+p}$. Column (5) of Table 4 reports the relevant moments when the assumed stigma premium is set to 2,500 basis points, $p = 0.25$. This analysis underscores critical dynamics: for the government to refrain from using these credit lines, the effective rate would need to increase by nearly 2,500 basis points.

Apart from the stigma premium, this analysis also highlights the important role of grace periods. Notably, the sovereign continues to tap credit lines despite their significant costs. For example, when $p = 0.05$, the share of credit lines in budget balances disappears. However, if we remove the grace period from the model, the uptake of these credit lines declines, especially when an extra premium is involved. This outcome reflects the sovereign's impatience. Although credit lines accrue interest, maintaining a constant net present value during the grace period, an impatient government prefers them as it avoids coupon payments for the next 10 years after its access.

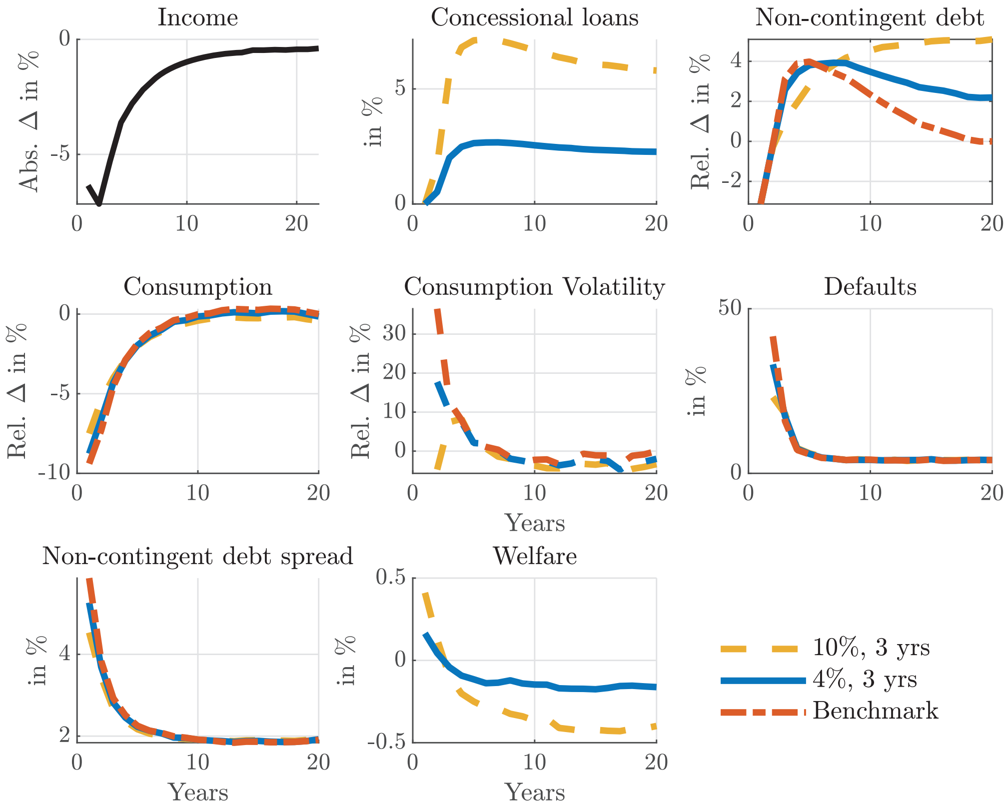

Figure 7: Impulse Response Functions. The figure illustrates the behavior of key variables following a simultaneous shock to each economy, which starts with an initial average debt level (as in the baseline economy) and is jointly affected by a local shock and a negative income shock of two-and-a-half standard deviations. The local shock lasts for one year, while the income shock follows its recovery path, as depicted in the upper left chart. Credit lines, defaults, spreads, and welfare are shown in levels, while other variables are expressed as percentage deviations from the baseline. The blue solid line represents the case where the grace period is set to 3 years with a credit line cap of 4%, while the dashed yellow line represents the economy with credit lines and a 3-year grace period with a credit line cap of 10%. The red dashed-dotted line corresponds to the benchmark.

3.6.4 Lower credit line limit

In this analysis, we explore the model dynamics by imposing a lower cap on the available credit lines, specifically setting it to 4% of GDP, i.e., $\overline{b_C} = 0.04$, as opposed to the

10% used in the main analysis. This adjustment is consistent with existing proposals for the European Stability Mechanism (ESM) credit line (see Misch and Rey (2022)). The IRFs for this analysis are shown in Figure 7.

Several trade-offs emerge with this lower cap. While the reduction in the government's default probability and spreads in the next period is less pronounced upon its introduction, long-term consumption and welfare are higher than under the higher cap counterpart while long-term debt is lower. It is important to recall that during a local shock, the government's gross financing needs increase by 10%, but the reduced credit lines can only partially finance this.

A potential drawback of the 4% cap is that it may prevent the sovereign from achieving its long-term debt target of 60% through a voluntary debt exchange (highlighted in Section 3.5).

4 Conclusion

This paper develops an endogenous sovereign default model to quantify the benefits of providing long-term credit lines with grace periods that are only accessible during "risk-on" episodes, defined by elevated gross government financing needs. Our results, calibrated to Portugal, suggest that credit lines help mitigate default risks when they are first introduced. In the long run, however, the inclusion of grace periods in the contracts leads to higher debt and wider spreads, as they exacerbate the debt dilution problem, unless they are conditional on debt breaks, such as the use of the funds to meet a 60% debt-to-GDP threshold. As reducing debt to sustainable levels in the wake of large fiscal stimulus plans across the euro area has become a key policy concern, credit lines, combined with voluntary debt swaps and debt brakes, can play a crucial role in ensuring financial stability.

We also show that if credit lines are designed in such a way that they are continuously available during only risk-on episodes with no grace periods attached to it, and are short-term in their duration, then spreads also decline in the long run. This approach enables credit lines to complement the market effectively while avoiding any worsening of the debt dilution issue.

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