# Seniority and Sovereign Default: The Role of Official Multilateral Lenders*

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**Abstract**

This paper studies official multilateral lending in the sovereign debt market. Official multilateral debt receives priority in repayment, even though this is not legally required. It represents an important portion of total sovereign debt and increases both before and during a default. Defaults on official multilateral debt are infrequent, last relatively longer and are associated with greater private lenders losses. I develop a model with private and official multilateral lenders where the latter benefits from a greater enforcement power in repayment. This allows the model to rationalize the aforementioned empirical facts and generates non-monotonicity in the private bond price. In small amount, official multilateral debt has a positive catalytic effect which is quantitatively strong but short lived. Sovereign borrowers value the use of official multilateral debt and would not necessarily prefer other seniority regimes.

**Keywords:** sovereign debt, default, seniority, official lending

**JEL Classification:** E43, F34, F36, F37, O11, O19

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# 1 Introduction

Sovereign borrowers do not necessarily repay all their lenders. There is a clear pecking order in which (official) multilateral lenders – mainly the International Monetary Fund (IMF) and the World Bank (WB) – are given priority in repayment. Yet, legally speaking, nothing enforces this pecking order. In other words, sovereign borrowers give a special rank to multilateral lenders even though they have no legal obligations to do so. This suggests the existence of a *de facto* – as opposed to *de jure* – seniority structure. The present study investigates multilateral debt both empirically and theoretically and documents the consequences of its *de facto* seniority.

I begin this inquiry by establishing new empirical facts on multilateral debt based on 72 countries and 187 default episodes on external private debt from 1970 to 2014. At present, multilateral debt is the second largest category of sovereign borrowing after bonds. It carries interest rates close to the risk-free rate and tends to increase both before and during a default. Defaults on multilateral debt are infrequent. However, they last longer taking roughly 9 years to be resolved, while other types of default last on average 3 years. Moreover, they are associated with greater private lenders losses. The average haircut is 59% for defaults on multilateral debt, while it is 33% otherwise. All these facts hold after controlling for the countries economic and political characteristics.

Having identified the main empirical facts on multilateral debt, I build a model capable of rationalizing them. I first consider a simple version of the model with one-period debt and two types of lenders: a continuum of competitive private lenders and a multilateral lender. The borrower can decide to default either on private lenders – *partial* default – or on both lenders – *full* default. I assume that the multilateral lender has a greater enforcement power in repayment. Especially, *full* defaults are followed by a greater output penalty and the defaulted multilateral debt has a greater recovery value than the defaulted private debt.

The main outcome of the model is that the greater enforcement power of the multilateral lender generates non-monotonicity in the private bond price. When multilateral debt is relatively small, a *full* default is unattractive owing to the greater output penalty and the recovery value of defaulted multilateral debt. Nevertheless, the multilateral debt has to be repaid in a *partial* default. Hence, more multilateral debt reduces *partial* default incentives. The private bond price therefore increases with more multilateral debt when such debt remains small. In opposition, when the multilateral debt is large, the previous argument reverses and a *partial* default becomes unattractive. The private bond price increases with more multilateral debt due to greater *full* default incentives. As a result, the multilateral debt has a positive catalytic effect only when it remains small. Quantitatively, this effect reduces the interest rate spread of private debt by 45% on average but vanishes after 3 years.

The optimal bond portfolio is the outcome of a tradeoff between repayment incentives and insurance. On the one hand, the multilateral debt generates a large value at the issuance. It is therefore more effective at providing incentives to repay than the private debt. This is what I call the seniority benefit. On the other hand, the multilateral debt is more costly to default on than the private debt. Hence, the private debt can be more easily repudiated when the endowment suddenly drops. This is what I call the subordination benefit. The balance between those two benefits define the optimal bond portfolio.

I extend the analytical model to a quantitative model with long-term debt. Moreover, to obtain predictions about the haircut and the default duration, I endogenize the renegotiation upon default as a multi-round non-cooperative bargaining game between the borrower and the lenders. I assume that the multilateral lender follows a policy of non-toleration of arrears characteristic of the IMF's and the WB's practice. More precisely, it requests full repayment and does not lend until arrears have been cleared. Besides this, an exogenous probability governs potential miscoordination between the two types of lender. Quantitatively miscoordination is mild, though. I finally add a borrowing limit on multilateral debt to reflect the lending quotas imposed by the IMF and the WB.[1]

The quantitative model predicts larger haircuts and longer default durations in *full* defaults than in *partial* defaults. This is mainly a consequence of the non-toleration of arrears which renders restructurings more costly. In particular, the borrower can issue new multilateral debt only after clearing arrears – i.e. after the restructuring. This combined with the full repayment of outstanding multilateral debt reduces the borrower's value of restructuring which in turns increases both the private lenders losses and the default duration. In addition, the multilateral debt increases prior to and during a *full* default. The latter effect comes from the fact that the full repayment includes *part of* the accumulated arrears, while the former effect is the outcome of the optimal bond portfolio choice. The full repayment and the inclusion of part of the accumulated arrears also safeguard the preferential rate of multilateral lending. Finally, the greater output penalty controls the frequency of *full* defaults and the borrowing limit commands the multilateral debt ratio.

The model is calibrated to match moments related to Argentina. The aforementioned empirical facts on the timing of multilateral lending, private lenders losses and the default duration are untargeted. I find that the model fits the data particularly well. Given this, I conduct a series of counterfactual analyses. I first consider the model without multilateral debt and find mostly welfare losses for the borrower relative to the benchmark model. I subsequently study two alternative seniority regimes: full enforceability and *pari passu.*

[1]Note that I abstract from conditionality in lending which is another aspect of multilateral lending.

Again, I find mostly welfare losses especially in regions of debt crises. Full enforceability of multilateral debt is too strict and does not allow for full debt repudiation, while a *pari passu* clause drastically limits the last-resort property of the multilateral debt. Hence, the borrower values multilateral debt and would not necessarily prefer other seniority regimes.

The paper is organized as follows. Section 1.1 reviews the existing literature and Section 1.2 introduces the institutional background. Section 2 presents the empirical analysis. Section 3 describes the economic environment of the model. Sections 4 and 5 develop the analytical and quantitative model, respectively. Section 6 presents the calibration and the result of the quantitative analysis. Finally, Section 7 concludes.

## 1.1 Related Literature

I contribute to the empirical literature on sovereign debt by analyzing official multilateral lending. In comparison, Boz (2011) focuses on the IMF, while Horn et al. (2020) and Arellano and Barreto (2024) consider the entire official lending. In addition, I present evidence that haircuts and default durations are larger in defaults involving multilateral lenders. This relates to Asonuma and Trebesch (2016) who show that post-default restructurings are associated with longer durations and larger haircuts than preemptive restructurings. Similarly, Asonuma and Joo (2020) document that the foreign lenders economic conditions largely influence the length and the terms of a restructuring. Also Asonuma et al. (2023) present evidence that haircuts are greater on short-term bondholders. Besides this, my analysis complements the work of Schlegl et al. (2019) who show that the multilateral lenders enjoy the highest seniority among sovereign lenders.

My models builds on the canonical sovereign debt model of Eaton and Gersovitz (1981), Aguiar and Gopinath (2006) and Arellano (2008).[2] It adopts the long-term debt specification of Hatchondo and Martinez (2009) and Chatterjee and Eyigungor (2012) and the renegotiation protocol of Bi (2008), Benjamin and Wright (2013) and Dvorkin et al. (2021). Moreover, it introduces two types of lenders with different enforcement power in repayment. This is distinct from Arellano and Barreto (2024) who extend the model of Arellano et al. (2023) with two lenders which lend at different maturities and concessionalities. Moreover, unlike Boz (2011), Fink and Scholl (2016) and Hatchondo et al. (2017), I do not assume full enforceability of multilateral debt. My study is the closest to Dellas and Niepelt (2016) and Ari et al. (2018) who associate greater enforceability with greater output penalty and to Bolton and Jeanne (2009) who associate lower enforceability with easy renegotiation. Seniority is therefore an assumption of the model, whereas Cordella and Powell (2021) endogenize it

[2] See also Aguiar and Amador (2014), Aguiar et al. (2016) and Aguiar and Amador (2021).

through commitment in lending. My contribution to this literature is twofold. First, I show that the tradeoff between senior and junior debt is similar to the one between short-term and long-term debt in Arellano and Ramanarayanan (2012) and Niepelt (2014). Second, the introduction of two lenders with different but partial enforcement power in repayment generates non-monotonicity in the junior bond price.

Finally, my analysis relates to the literature on official multilateral lending. Building on Ábrahám et al. (2019), Liu et al. (2023) find that the seniority of multilateral lenders is not necessarily preferable to a *pari passu* regime. In opposition, I show that their seniority is necessary to maintain the last-resort function of multilateral lending. Such function often relates to the catalytic effect of multilateral lending which has been shown theoretically by Corsetti et al. (2006), Morris and Shin (2006) and Rochet and Vives (2010). However, empirical analyses remain inconclusive and present at most mixed evidence. Focusing on the IMF, the most recent studies have therefore sought to explain this ambivalence. For instance, Krahnke (2020) shows that the seniority of the IMF can lead to a crowding-out of private funds if the IMF support is sufficiently large. I document a similar mechanism analytically and show quantitatively that the positive catalytic effect is strong but short lived. Analyzing the introduction of risk-free bonds into a sovereign default model, Hatchondo et al. (2017) find similar results. Finally, I stress the importance of the policy of non-toleration of arrears in multilateral lending as in Cordella and Powell (2021).

## 1.2 Institutional Background

Having supreme and unrestricted power as a sovereign state, a government can always choose to breach the terms of its debt obligations. Despite major improvements in the 1990s, international law remains limited in enforcing repayment of sovereign debt and offers little guidance on the repayment priority of lenders (Panizza et al., 2009; Schumacher et al., 2021). Furthermore, there exists no supranational entity capable of prosecuting defaults on sovereign debt. Thus, the seniority of sovereign debt is mostly implicit (Martha, 1990; Gelpern, 2004). That is why one refers to a *de facto* seniority, as a matter of *ex post* conduct, in contrast to a *de jure* seniority, as a matter of *ex ante* legal requirement.

More precisely, a *de jure* seniority relates to *ex ante* enforceable legal clauses that give priority to some lenders. In opposition, a *de facto* seniority does not originate from initial contracting clauses or laws. Rather it is a feature that is the result of some *ex post* practice or convention. The multilateral lending institutions such as the IMF and the WB enjoy *de facto* seniority.[3] Neither the IMF's nor the WB's Articles of Agreement mention any seniority or

[3]See notably Jeanne and Zettelmeyer (2001), Roubini and Setser (2003), Gelpern (2004), Raffer (2009),

preferred lender status (Raffer, 2009). However, the market participants acknowledge and respect this implicit seniority (Schlegl et al., 2019). That is, those lending institutions are paid ahead of other lenders and, when payments are deferred, are usually repaid in full.

To maintain this preferred status, multilateral lenders have developed a set of policies. For example, the IMF has established a clear policy of non-toleration of arrears consisting of two main lines of conduct.[4] First, it does not tolerate defaults on official lenders and forbids the use of funds to member states with arrears to the IMF (IMF, 1989; IMF, 2015). Second, if a country receives support from an IMF program and defaults on its private lenders, the program should, absent immediate corrective actions, be suspended (IMF, 1999). The WB follows a similar scheme as it does not lend into arrears and reserves the right to withdraw its funds in case of lacking reforms (IDA, 2007; IBRD, 2021). Finally, both the WB and the IMF impose lending quotas (Boz, 2011; Cordella and Powell, 2021).

# 2 Empirical Facts

I present 6 empirical facts about multilateral debt. My analysis relies on 72 countries and 187 default episodes on external private debt from 1970 to 2014.

Data on debt and interest rates come from the IMF and the WB. Data on default durations and haircuts come from Asonuma and Trebesch (2016) and Cruces and Trebesch (2013), respectively. The dataset of Beers et al. (2022) identifies the different lenders involved in each default. I focus on multilateral lenders which consist of the IMF and the WB.[5] A default episode *with* multilateral lenders consists of an episode in which a country defaults on at least one of the these two institutions.[6] The alternative case corresponds to a default *without* multilateral lenders. Appendix A gives a more detailed overview of the data.

The first empirical fact relates to the size of multilateral debt in the sovereign debt market. Figure 1a depicts the share of multilateral debt over the total sovereign debt for the 72 countries in the sample.[7] Three comments are in order. First, the IMF and the WB represent the majority of the multilateral sovereign lending. Second, the WB is the

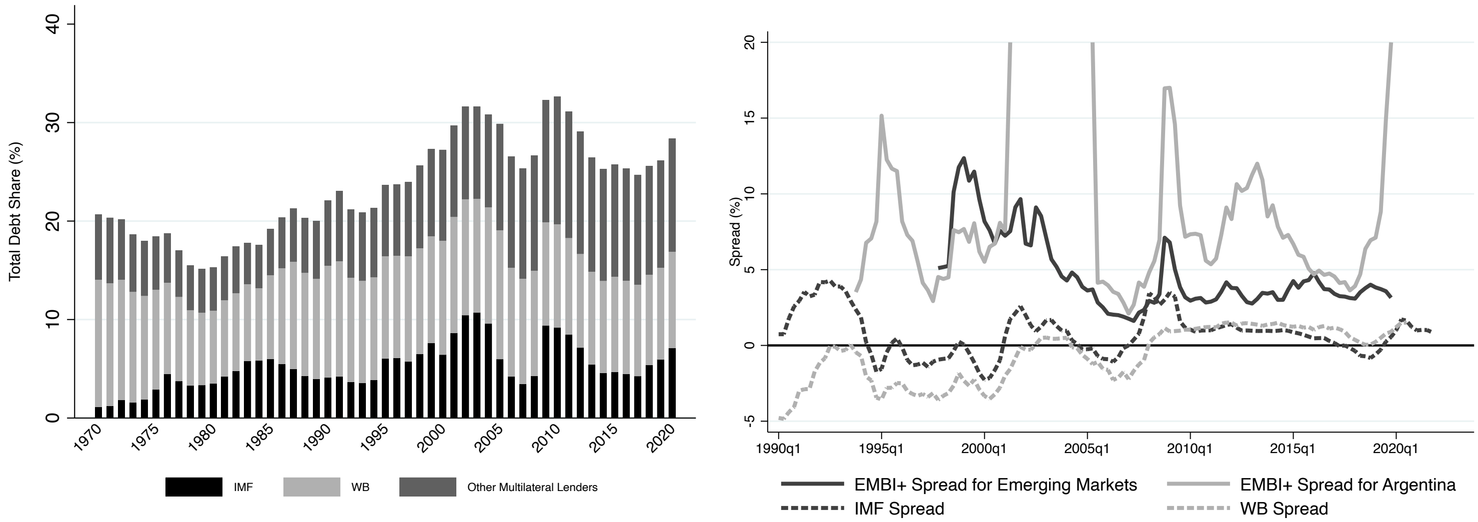
Schadler (2014) and Schlegl et al. (2019).

[4]The IMF's policy of non-toleration of arrears has evolved over time. Moreover, as noted by Reinhart and Trebesch (2016), the IMF applies this policy with some degrees of freedom. See Buchheit and Lastra (2007) for the history of the policy and Erce (2014) for a critical appraisal.

[5]The WB is composed of the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA).

[6]As noted by Cordella and Powell (2021), multilateral lenders do not identify these episodes as defaults but simply as arrears because they eventually expect full repayment. I nevertheless use the term default as it corresponds to a missed payment consistent with the definition of Asonuma and Trebesch (2016).

[7]The result is similar if one considers a broader set of countries. See Schlegl et al. (2019, Figure 1).




(a) Debt Share

(b) Interest Rate Spread

*Note*: Figure 1a depicts the share of multilateral sovereign debt over the total sovereign debt for the 72 countries included in the sample. The category Other Multilateral Lenders refers to regional development banks and other intergovernmental agencies different from the IMF and the WB. Figure 1b depicts the interest rate spread for different types of sovereign debt. The EMBI+ spread for Argentina has been truncated to 20% for expositional reasons. The IMF spread corresponds to the adjusted rate of charge minus the yield on 1-year US government bonds. The WB spread is the mean of the IBRD lending rate and the IDA service charge minus the aforementioned yield.

Figure 1: Multilateral Debt Share and Spread

dominant single multilateral lender.[8] Third, multilateral lenders have always been important representing 28.2% of the total in the last 20 years. Yet they are only the second largest source of sovereign lending. At present, bonds represent the largest portion with 39.1% of the total in the last 20 years.[9]

**Fact I.** *Multilateral debt is an important share of total sovereign debt but not the largest.*

The second empirical fact relates to the rates at which multilateral lenders lend. Figure 1b depicts the spread of the IMF and the WB lending rates with respect to the yield on 1-year US government bonds. It also presents the EMBI+ spread for Argentina and emerging economies. As one can see, multilateral lenders always charge rates close to the risk-free rate, while private lenders can request substantial risk premia.[10] Boz (2011) and Fink and Scholl (2016) already highlighted this particularity for the IMF.

[8]The WB debt represents on average 72% of the sum of the WB and the IMF debt across the 72 countries in the sample.

[9]Bonds are the largest source of sovereign lending since the end of the 1990s and the emergence of Brady bonds. In the 1970s, bilateral loans represented the largest portion of sovereign debt, while bank loans were predominant from the 1980s until the middle of the 1990s.

[10]From 1970 to 2022, the quarterly average IMF, IBRD and IDA spreads are 0.76%, 0.37% and $-1.54\%$, respectively. In opposition, the quarterly average EMBI+ spread for Argentina and emerging economies amount to 14.43% and 4.61%, respectively.

**Fact II.** *Multilateral debt carries interest rates close to the risk-free rate.*

The third empirical fact relates to the timing of multilateral lending. The first part of Table 1 reports the sum of the IMF and the WB debt as a share of GDP. There are two key takeaways. First, countries hold multilateral debt outside of default. Second, multilateral debt is larger before and during a default. Arellano and Barreto (2024) also highlight this peculiarity for official debt in general.

Table 1: Multilateral Debt, Duration and Haircut Statistics

| | Mean | p25 | p50 | p75 | Std. Dev. | Obs. |
|---|---|---|---|---|---|---|
| IMF and WB Debt (% GDP) | | | | | | |
| Outside default | 7.11 | 0.54 | 3.23 | 8.59 | 11.29 | 2276 |
| At default start | 8.22 | 1.36 | 5.80 | 11.55 | 8.98 | 187 |
| Inside default | 15.26 | 3.91 | 9.11 | 18.31 | 24.71 | 768 |
| | | | | | | |
| Default Duration (year) | | | | | | |
| Overall | 3.65 | 0.92 | 1.58 | 4.67 | 4.73 | 187 |
| With multilateral lenders | 8.55 | 2.08 | 7.58 | 11.75 | 7.07 | 33 |
| Without multilateral lenders | 2.60 | 0.75 | 1.33 | 2.83 | 3.23 | 154 |
| | | | | | | |
| SZ Haircut on Private Lenders (%) | | | | | | |
| Overall | 37.52 | 15.40 | 32.50 | 52.70 | 27.93 | 187 |
| With multilateral lenders | 58.99 | 34.60 | 55.20 | 88.60 | 27.68 | 33 |
| Without multilateral lenders | 32.92 | 13.70 | 29.00 | 46.00 | 25.83 | 154 |

*Note*: The table depicts the IMF and WB debt as a share of GDP in percent, the default duration in years and the haircut on private lenders in percent. SZ haircuts are computed according to Sturzenegger and Zettelmeyer (2008).

To go beyond the analysis of simple stylised facts, I conduct a more comprehensive econometric analysis. However, for the continuity of the argument, I only highlight here the main findings. The econometric analysis is presented in Appendix B. There, I run panel regressions with country fixed effects. Controlling for the economic and political stands of each country, the increase in IMF and WB debt is statistically and economically significant both before and during a default. The increase is more pronounced during a default, though.

**Fact III.** *Multilateral debt increases before and during a default.*

The fourth empirical fact relates to the frequency of a default with multilateral lenders. Out of the 187 default episodes presented here only 33 are with multilateral lenders.[11] The remaining 154 default episodes are without multilateral lenders.

[11] Out of these 33 defaults, 14 involve both the IMF and the WB, 16 involve the IMF only and the remaining 3 involve the WB only.

**Fact IV.** *A default with multilateral lenders is infrequent.*

The fifth empirical fact relates to the duration of a default with multilateral lenders. As shown in the second part of Table 1, sovereign defaults take between 3 and 4 years to be resolved on average. However, a default with multilateral lenders takes roughly 9 years to be resolved, whereas a default without such lenders takes 3 years. Looking at the median the wedge between the two statistics is even larger.

**Fact V.** *A default with multilateral lenders takes longer to be resolved.*

Similar to Fact III, I conduct a comprehensive econometric analysis in Appendix B. I run ordinary least squares (OLS) regressions and Cox proportional hazard (Cox) duration regressions where I control for the economic and political stands of each country. Importantly, I control for IMF programs and debt, WB adjustment loans and debt as well as the HIPC initiative.[12] There is a strong and positive association between defaults with multilateral lenders and the default duration for both the OLS and the Cox regressions.

The last empirical fact relates to the private lenders losses in a default with multilateral lenders. The third part of Table 1 presents the private lenders haircut computed according to Sturzenegger and Zettelmeyer (2008) (SZ). The average haircut is 38%. However, for default episodes with multilateral lenders, the average haircut raises to 59%, while it falls to 33% otherwise. The same holds true for the median.

**Fact VI.** *A default with multilateral lenders is related to larger private lenders losses.*

Similar to Facts III and V, I run OLS regressions in Appendix B. Using the same control variables as for the duration regressions, the coefficient related to multilateral lenders is economically important although the statistical significance is slightly less pronounced than for the other regressions.

Having established new empirical facts, the following sections aim at building a model capable of rationalizing them.

# 3 Environment

I consider a small open economy in infinite discrete time $t = \{0, 1, \dots\}$ with a single homogenous good. There is a benevolent government (i.e. the borrower) which can borrow from two foreign lenders: a continuum of competitive private lenders and a multilateral lender.

[12] In 1996, the IMF and the WB started the Heavily Indebted Poor Countries (HIPC) initiative which aims at providing immediate debt relief to selected low-income countries.

The government takes the decision on behalf of the small open economy. Preference over consumption is given by $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$ where $\beta \in (0,1)$ is the discount factor and $c_t$ denotes the consumption at time $t$. The instantaneous utility function $u(\cdot)$ is differentiable, strictly increasing and strictly concave. Moreover, the government is relatively impatient meaning that $\beta(1+r) < 1$ where $r$ is the exogenous risk-free rate. Each period the government receives an endowment, $y(z)$, which follows a first-order Markov process with a discrete compact support $Z$. I denote $\mathbb{E}_{z'|z}$ as the expectation over $z'$ given $z$, $z_{min} = \arg\min\{y(z)\}$, $z_{max} = \arg\max\{y(z)\}$ and $\overline{y}$ as the mean endowment.

There are two types of bonds: private denoted by $b_p$ and multilateral denoted by $b_m$. I consider that $b_i < 0$ denotes a debt, while $b_i > 0$ denotes an asset for all $i \in \{m, p\}$. I focus on borrowing only, i.e. $(b_m, b_p) \leq 0$. Both types of bond follow the structure of Chatterjee and Eyigungor (2012). More precisely, a fraction $1-\delta$ of the bond matures every period and the remaining fraction $\delta$ is rolled over and pays a coupon $\kappa$. If $\delta = 0$ the bond is one period and if $\delta = 1$ it is a perpetuity. Both multilateral and private bonds have the same $(\kappa, \delta)$ and the risk-free return is given by $\bar{q} \equiv \frac{1-\delta+\delta\kappa}{1+r-\delta}$.

There is limited enforcement in repayment. The government has two default options: *partial* or *full*. In the former case, the government solely defaults on its private debt, whereas in the latter case it defaults on its entire debt position. Both types of default are followed by a complete bond market exclusion and an output penalty. I denote by $y^{DP}(z)$ and $y^{DF}(z)$ the endowment upon entry of a *partial* and a *full* default, respectively. Upon continuation of a *partial* or a *full* default, the endowment is given by $y^D(z)$.

The private lenders are risk-neutral and competitive. Similarly, the multilateral lender is risk-neutral and breaks even in expectation. Nevertheless, the multilateral lender has a greater enforcement power in repayment than the private lenders. First, defaulting on the multilateral debt entails greater output cost, $y \geq y^{DP} > y^{DF}$.[13] Second, the multilateral lender receives a greater repayment than the private lenders upon default.

The timing of actions is as follows. If the government has not defaulted previously, it decides whether to repay or not. If it repays, it can issue new multilateral and private debt. Upon default, the government receives the output penalty, is excluded from the bond market and renegotiates with the lenders. Upon successful renegotiation, it can regain access to the bond market and gets rid of the output penalty. I first assume an exogenous renegotiation process in Section 4 that I then endogenize in Section 5.

[13]There are many ways to rationalize this greater output penalty. First, multilateral lenders provide support to and advise countries during debt crises. Such aid is often conditional on not having arrears towards those institutions. Second, multilateral lenders represent large players in the sovereign debt market capable of influencing other market actors. See also Dellas and Niepelt (2016, Section 2).

# 4 Analytical Model

I first consider a simplified version of the model. I assume that $\delta = 0$ meaning that bonds are one period. In addition, $y^{DP} = y^{D} = y$ and $y^{DF} = y + \varkappa$ with $\varkappa < 0$ implying that there is a constant output penalty upon entry in a *full* default. Finally, the repayment of multilateral and private debt upon default is exogenously fixed to 0 and $\eta < 0$, respectively.

## 4.1 Decision problem

The overall beginning of the period value function is given by

$$V(z, b_m, b_p) = \max\left\{V^P(z, b_m, b_p), V^{DP}(z, b_m), V^{DF}(z)\right\}, \tag{1}$$

where $V^P(\cdot)$ is the value function under repayment, $V^{DP}(\cdot)$ under *partial* default and $V^{DF}(\cdot)$ under *full* default. In repayment, the value is given by

$$\begin{aligned} V^P(z, b_m, b_p) = & \max_{b'_m, b'_p} \left\{u\left(c\right) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p)\right\} \\ & \text{s.t.} \quad c + q_m(z, b'_m, b'_p) b'_m + q_p(z, b'_m, b'_p) b'_p = y(z) + b_m + b_p, \end{aligned} \tag{2}$$

where $q_m(\cdot)$ and $q_p(\cdot)$ correspond to the unit price of multilateral and private bonds, respectively. If the borrower decides to enter into *partial* default, it is excluded from the bond market and repays the multilateral debt. The value of *partial* default is given by

$$V^{DP}(z, b_m) = u\left(y(z) + b_m\right) + \beta \mathbb{E}_{z'|z} \max\left\{V^{DP}(z, 0), V^P(z, 0, 0)\right\}. \tag{3}$$

The recovery value of private debt is zero and the borrower can always decide to stay in autarky or to re-enter the market in the next period. Finally, the value of *full* default is

$$V^{DF}(z) = u\left(y(z) + \varkappa\right) + \beta \mathbb{E}_{z'|z} \max\left\{v^{DF}(z), V^P(z, \eta, 0)\right\}, \tag{4}$$

where $v^{DF}(z) = u\left(y(z)\right) + \beta \mathbb{E}_{z'|z} \max\{v^{DF}(z), V^P(z, \eta, 0)\}$ due to the different output penalty upon entry and continuation of a *full* default. The repayment of multilateral debt is $\eta < 0$. This together with the cost $\varkappa < 0$ come from the assumption of greater enforcement power of the multilateral lender.

## 4.2 Bond prices

Define $D^{DP}(z, b_m, b_p)$ as the *partial* default policy which takes value one if $V^{DP}(z, b_m) > V^P(z, b_m, b_p)$ and $V^{DP}(z, b_m) \geq V^{DF}(z)$ and zero otherwise. Similarly, define $D^{DF}(z, b_m, b_p)$ as the *full* default policy which takes value one if $V^{DF}(z) > \max\{V^P(z, b_m, b_p), V^{DP}(z, b_m)\}$ and zero otherwise. Regarding borrowing, $H_m(z, b_m, b_p) = b'_m$ and $H_p(z, b_m, b_p) = b'_p$ correspond to the multilateral and private bond policies, respectively, with $\boldsymbol{H}(z, b_m, b_p) \equiv (H_m(z, b_m, b_p), H_p(z, b_m, b_p))$.

Private lenders are competitive meaning that in expectations they make zero profit. The private bond price is therefore given by

$$q_p(z, b'_m, b'_p) = \frac{1}{1+r}\mathbb{E}_{z'|z}\Big[1 - D^{DP}(z', b'_m, b'_p) - D^{DF}(z', b'_m, b'_p)\Big]. \tag{5}$$

Similarly, given the break-even assumption, the multilateral bond price is

$$q_m(z, b'_m, b'_p) = \frac{1}{1+r}\mathbb{E}_{z'|z}\Big[\big(1 - D^{DF}(z', b'_m, b'_p)\big) + D^{DF}(z', b'_m, b'_p)q_m^{DF}(z', b'_m)\Big], \tag{6}$$

where the recovery value is $q_m^{DF}(z, b'_m) = \frac{1}{1+r}\mathbb{E}_{z'|z}[(1 - A^{RF}(z'))q_m^{DF}(z', b'_m) + A^{RF}(z')\frac{\eta}{b'_m}]$ with $A^{RF}(z')$ taking value one if $V^P(z', \eta, 0) \geq v^{DF}(z')$ and zero otherwise. If the borrower decides to re-enter the market, then the recovery value per unit of bond is $\frac{\eta}{b'_m}$. In the opposite case, the borrower does not disburse anything now, but in present value it pays $q_m^{DF}(z', b'_m)$.

An equilibrium is such that the default policies, $D^{DP}(z, b_m, b_p)$ and $D^{DF}(z, b_m, b_p)$, satisfy (1) and the bond policies, $H_m(z, b_m, b_p)$ and $H_p(z, b_m, b_p)$, satisfy (2) taking as given the bond prices, $q_p(z, b'_m, b'_p)$ and $q_m(z, b'_m, b'_p)$, which satisfy (5) and (6), respectively. Given this, I can establish three main analytical results to characterize the bond prices. Proofs can be found in Appendix C.

First, there are two threshold values $b_m^{**} \leq b_m^* < \varkappa$ which separate the state space. On the one hand, for any $b_m \geq b_m^*$ there is no *full* default. The reason is that a *full* default involves the recovery payment of $\eta < 0$ upon restructuring and the output cost $\varkappa$ upon default entry. In opposition, a *partial* default solely involves the repayment of $b_m$ upon default entry. When $b_m \geq b_m^*$, this repayment is relatively small such that a *full* default is not optimal. On the other hand, for any $b_m < b_m^{**}$, there is no *partial* default. This is because the repayment of $b_m$ has become large enough to compensate the output cost $\varkappa$ and the recovery payment $\eta$.

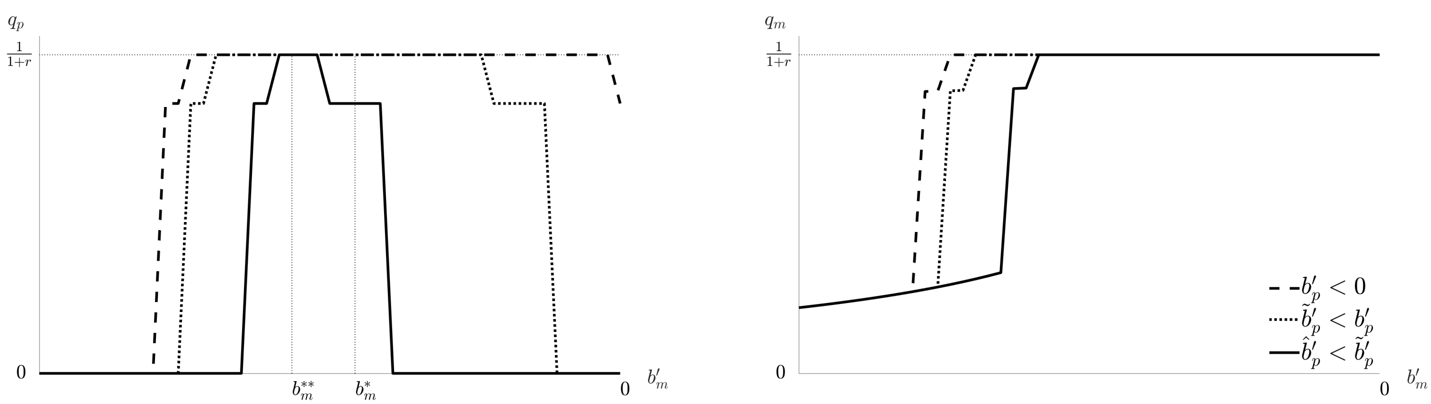
**Proposition 1.** *There are two threshold values $b_m^{**} \leq b_m^* < \varkappa$ such that if $b_m < b_m^{**}$ there is no risk of partial default and if $b_m \geq b_m^*$ there is no risk of full default.*

The second analytical result is that the multilateral bond price is larger than the private bond price. The reason is that, in a *partial* default, the multilateral debt is repaid and, in a *full* default, the recovery value of multilateral debt is larger than the one on private debt.

**Proposition 2.** *$q_m(z, b'_m, b'_p) \geq q_p(z, b'_m, b'_p)$ for all $(z, b'_m, b'_p)$ with strict inequality when there is a risk of partial or full default with market re-entry.*

The last and most important analytical result is that the private bond price is not monotone in $b_m$. When $b_m < b_m^{**}$, more multilateral debt increase the probability of a *full* default. The reason is that the value of repayment increases in $b_m$, while the value of *full* default is independent of $b_m$. This is the standard argument in the canonical sovereign default model. In opposition, when $b_m \geq b_m^*$, this argument does not apply as there is no *full* default. Instead, the borrower can enter in *partial* default where it repays $b_m$. Hence, both the value of repayment and the value of *partial* default increase in $b_m$. However, the latter increases relatively more given the lack of market access. Additional multilateral debt reduces consumption in *partial* default one-to-one, while it can be compensated by new debt issuances in repayment. As a result, *partial* default incentives increase in $b_m$. From (5), this implies that the private bond price decreases in $b_m$ when $b_m \geq b_m^*$ and increases in $b_m$ when $b_m < b_m^{**}$.[14]

**Proposition 3.** *$q_m(z, b'_m, b'_p)$ is increasing in $(b'_m, b'_p)$ and $q_p(z, b'_m, b'_p)$ is increasing in $b'_p$. Moreover, $q_p(z, b'_m, b'_p)$ is increasing in $b'_m$ if $b'_m < b_m^{**}$ and decreasing in $b'_m$ if $b'_m \geq b_m^*$ .*




(a) $q_p$

(b) $q_m$

Figure 2: Bond Prices – Analytical Model

Figure 2 gives a graphical illustration of the two bond prices. The different lines correspond to different levels of private debt. The private bond price has an inverse U shape in $b'_m$, while the multilateral bond price is increasing in $b'_m$. The effect of multilateral debt

[14]If $b_m \in [b_m^{**}, b_m^*)$, the private bond price can either increase or decrease in $b_m$ as both *partial* and *full* defaults can occur.

on the private bond price addresses the catalytic function of the multilateral lender. While small amounts of multilateral debt enhance the terms of private borrowing, large amounts have the opposite effect. The catalytic function is therefore effective only in one part of the state space which I call the *catalytic finance region*.

## 4.3 Optimal bond portfolio

To understand the tradeoff involved in the borrowing decision, I analyze the optimality conditions of the borrower. As Arellano and Ramanarayanan (2012) and Arellano et al. (2023), I assume that the bond prices $q_m(\cdot)$ and $q_p(\cdot)$ and the value of repayment $V^P(\cdot)$ are differentiable everywhere and the bond choices have a continuous and compact support.[15] Given this, the first-order condition of (2) with respect to $b'_m$ is,

$$u_c(c)\left[\frac{\partial q_m}{\partial b'_m}b'_m + q_m + \frac{\partial q_p}{\partial b'_m}b'_p\right] = \beta\left[\mathbb{E}^{R}_{z'|z}\left[u_c(c')\right] + \mathbb{E}^{DP}_{z'|z}\left[u_c(y(z') + b'_m)\right]\right], \tag{7}$$

and with respect to $b'_p$ is,

$$u_c(c)\left[\frac{\partial q_m}{\partial b'_p}b'_m + \frac{\partial q_p}{\partial b'_p}b'_p + q_p\right] = \beta\mathbb{E}^{R}_{z'|z}\left[u_c(c')\right], \tag{8}$$

where $u_c(\cdot)$ represents the first derivative of $u(c)$ with respect to $c$, $\mathbb{E}^{R}_{z'|z}$ is the expectation in repayment and $\mathbb{E}^{DP}_{z'|z}$ is the expectation in *partial* default. The left-hand side of each first-order condition represents the marginal benefit of issuing one additional unit of debt, whereas the right-hand side represents the marginal cost of this additional issuance.

The seniority benefit relates to the multilateral debt and is given by the ratio of the left-hand side of (7) and (8) each divided by the private debt price. The subordination benefit relates to the private debt and corresponds to the ratio of the right-hand side of the same two equations.

$$\text{Seniority benefit} = \frac{\frac{q_m}{q_p} + \frac{\partial q_m}{\partial b'_m}\frac{b'_m}{q_p} + \frac{\partial q_p}{\partial b'_m}\frac{b'_p}{q_p}}{1 + \frac{\partial q_m}{\partial b'_p}\frac{b'_m}{q_p} + \frac{\partial q_p}{\partial b'_p}\frac{b'_p}{q_p}},$$

$$\text{Subordination benefit} = \frac{\mathbb{E}^{R}_{z'|z}\left[u_c(c')\right] + \mathbb{E}^{DP}_{z'|z}\left[u_c(y(z') + b'_m)\right]}{\mathbb{E}^{R}_{z'|z}\left[u_c(c')\right]}.$$

[15] Clausen and Strub (2020) and Mateos-Planas et al. (2022) show that neither the price nor the value function are differentiable everywhere. However, this does not prevent the use of the generalized Euler equation to characterize the equilibrium.

When $b'_m \geq b^*_m$, $\frac{q_m}{q_p} \geq 1$, $\frac{\partial q_m}{\partial b'_p} = \frac{\partial q_m}{\partial b'_m} = 0$, $\frac{\partial q_p}{\partial b'_p} \geq 0$ and $\frac{\partial q_p}{\partial b'_m} \leq 0$ following Propositions 1-3. The seniority benefit reflects the fact that an additional unit of multilateral debt brings more resource than an additional unit of private debt at issuance. Especially, when $b'_m \geq b^*_m$, the multilateral debt trades at the risk-free rate and reduces *partial* default incentives. However, $\mathbb{E}^{DP}_{z'|z}\left[u_c(y(z') + b'_m)\right] \geq 0$ following Proposition 1. The subordination benefit reflects the fact that the multilateral debt is not repudiated in a *partial* default making it more costly to repay. There is therefore a clear tradeoff. On the one hand, the multilateral debt generates a larger value at the issuance. On the other hand, the private debt can be more easily repudiated when the endowment suddenly drops.

The optimal bond portfolio is such that the seniority benefit equates the subordination benefit. If there is a risk of *partial* default when $b'_m \geq b^*_m$, both benefits are greater than one.[16] The larger is this risk, the larger are $\frac{q_m}{q_p}$ and $\frac{\partial q_p}{\partial b'_m}\frac{b'_p}{q_p}$ which increase the seniority benefit and the larger is $\mathbb{E}^{DP}_{z'|z}\left[u_c(y(z') + b'_m)\right]$ which increases the subordination benefit. If the former (latter) effect dominates, the borrower issues more (less) multilateral debt. Hence, close to a *partial* default, the multilateral debt issuance can either increase or decrease.

In opposition, if $b'_m < b^{**}_m$, there are no *partial* defaults. The subordination benefit therefore vanishes as $\mathbb{E}^{DP}_{z'|z}\left[u_c(y(z') + b'_m)\right] = 0$. Moreover, $\frac{\partial q_p}{\partial b'_p} = \frac{\partial q_p}{\partial b'_m} \geq 0$. The equality comes from the fact that $V^P(z', b'_m, b'_p)$ is strictly increasing in $b'_m + b'_p$, while $V^{DF}(z')$ remains constant. However, $\frac{\partial q_m}{\partial b'_m} \geq \frac{\partial q_m}{\partial b'_p} \geq 0$ as the recovery value per unit of multilateral debt is $\frac{\eta}{b'_m}$. Given that the subordination benefit equates one when $b'_m < b^{**}_m$ and $\frac{q_m}{q_p} \geq 1$, the borrower issues more multilateral debt such that the seniority benefit equates one as well. Hence, close to a *full* default, the multilateral debt issuance increases.

The tradeoff between multilateral and private debt closely relates to the one between short-term and long-term debt shown by Arellano and Ramanarayanan (2012) and Niepelt (2014). The short-term debt has to be repaid in the next period, while only a fraction of the long-term debt matures. The price of long-term bonds therefore includes the prospective value of debt rendering it more sensitive to the default risk. Given this, the short-term debt has beneficial effects on the incentive to repay similar to the multilateral debt, whereas the long-term debt provides an hedge against future low endowments similar to the private debt.

[16] If there is no risk of *partial* default, the seniority and the subordination benefits equate one. As there is no risk of *full* default, both multilateral and private debt trade at the risk-free rate and the bond portfolio remains undetermined.

# 5 Quantitative Model

The analytical model assumed one-period bonds, constant output costs and exogenous recovery values upon default. I extent the analysis to a more general setting in which $\delta > 0$ and the output penalty is asymmetric. In addition, I endogenize the renegotiation as a multi-round non-cooperative bargaining game between the borrower and the lenders.

For computational reasons, I introduce additive utility shocks.[17] Debt takes values in a discrete support $B_p = \{b_{p,1}, \dots, b_{p,\mathcal{P}}\}$ with $|B_p| = \mathcal{P}$ for the private debt and $B_m = \{b_{m,1}, \dots, b_{m,\mathcal{M}}\}$ with $|B_m| = \mathcal{M}$ for the multilateral debt. I then define two vectors of length $\mathcal{J} \equiv \mathcal{P} \times \mathcal{M}$ as $\boldsymbol{b}_p = [B_p, \dots, B_p]$ and $\boldsymbol{b}_m = [b_{m,1}, \dots, b_{m,1}, b_{m,2}, \dots, b_{m,2}, \dots, b_{m,\mathcal{M}}, \dots, b_{m,\mathcal{M}}]$, where $(b_p^i, b_m^i)$ are the $i$th elements of each vector. There is a utility shock vector $\boldsymbol{\epsilon}$ of size $\mathcal{J} + 2$, which corresponds to the number of all possible combinations of the entries in $B_p$ and $B_m$ plus two additional elements accounting for the choices of *partial* and *full* defaults. I denote by $\mathbb{E}_{\boldsymbol{\epsilon}'}$ the expectation over the random vector $\boldsymbol{\epsilon}'$.

## 5.1 Repayment problem

The borrower faces two problems. On the one hand, it decides whether to repay. This is the repayment problem. On the other hand, under default, the borrower has to renegotiate its debt. This is the renegotiation problem which I analyze in the next subsection. In the repayment problem, the overall beginning of the period value function is given by

$$\overline{V}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = \max \left\{ \overline{V}^P(z, \boldsymbol{\epsilon}, b_m^i, b_p^i), \overline{V}^{DP}(z, \epsilon_{\mathcal{J}+1}, b_m^i, b_p^i), \overline{V}^{DF}(z, \epsilon_{\mathcal{J}+2}, b_m^i, b_p^i) \right\}.$$

The notation follows the one in Section 4 except that value functions, policy functions and prices are additionally denoted by an overline. In the case of repayment, the value is

$$\begin{aligned} \overline{V}^P(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = & \max_{j \in \{1,2,\dots,\mathcal{J}\}} \left\{ u(c) + \epsilon_j + \beta \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} \overline{V}(z', \boldsymbol{\epsilon}', b_m^j, b_p^j) \right\} \\ \text{s.t.} \quad & c + \overline{q}_m(z, b_m^j, b_p^j)(b_m^j - \delta b_m^i) + \overline{q}_p(z, b_m^j, b_p^j)(b_p^j - \delta b_p^i) + \varpi(b_m^j, b_p^j) = \\ & y(z) + [1 - \delta + \delta\kappa]\,(b_m^i + b_p^i), \\ & b_m^j \geq \mathcal{A}, \end{aligned}$$

[17] Without utility shocks, the maximization problem is not convex and cannot be solved using standard value function iterations. See Chatterjee and Eyigungor (2012) and Mateos-Planas et al. (2022).

I introduce an issuance cost $\varpi(\cdot)$ to avoid large shifts in consumption around defaults.[18] Moreover, I add a borrowing limit $\mathcal{A} \leq 0$ to reflect the fact that the IMF and the WB impose lending quotas. Quantitatively, this enables me to match the multilateral debt ratio observed in the data.[19] In the case of a *partial* default, the value is

$$\overline{V}^{DP}(z, \epsilon_{\mathcal{J}+1}, b^i_m, b^i_p) = u(y^{DP}(z) + [1 - \delta + \delta\kappa]\, b^i_m) + \epsilon_{\mathcal{J}+1} + \beta \mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\overline{V}^{RP}(z', \boldsymbol{\epsilon}', \delta b^i_m, b^i_p).$$

The continuation value $\overline{V}^{RP}(\cdot)$ is the expected payoff from the renegotiation with the private lenders and is specified in the next subsection. The borrower continues to service its multilateral debt which decays at the rate $\delta$. Hence, the longer is the maturity (i.e. $\delta \to 1$), the lower is the debt service incurred every period. Finally, in the case of a *full* default,

$$\overline{V}^{DF}(z, \epsilon_{\mathcal{J}+2}, b^i_m, b^i_p) = u(y^{DF}(z)) + \epsilon_{\mathcal{J}+2} + \beta \mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\overline{V}^{RF}(z', \boldsymbol{\epsilon}', b^i_m, b^i_p).$$

The continuation value $\overline{V}^{RF}(\cdot)$ is the expected payoff derived from the renegotiation with the multilateral and private lenders. Both $\overline{V}^{DP}(\cdot)$ and $\overline{V}^{DF}(\cdot)$ depend on the level of multilateral and private debt because of the endogenous renegotiation as shown next.

## 5.2 Renegotiation problem

The renegotiation problem is a multi-round non-cooperative bargaining game which builds on Bi (2008), Benjamin and Wright (2013) and Dvorkin et al. (2021). The main difference is the introduction of the multilateral lender which follows a specific policy of non-toleration of arrears. Consistent with the discussion in Section 1.2, such policy consists of two main elements. First, the repayment of outstanding multilateral debt is always in full. Second, the multilateral lender does not provide new debt until all arrears have been cleared.

### 5.2.1 Partial default

Once in *partial* default, with probability $\phi$, the private lenders have the opportunity to make an offer and if so the borrower decides whether to accept it. Conversely, with probability $1-\phi$, the borrower can make an offer and if so the private lenders decide whether to accept it. The probability $\phi$ reflects the private lenders bargaining power as it represents the probability of having the first-mover advantage (Merlo and Wilson, 1995).

[18] This follows from Dvorkin et al. (2021). For similar reasons, Hatchondo et al. (2016) impose a limit on the private bond spread and Fourakis (2021) adds a premium related to the default risk.

[19] Without the borrowing limit, the borrower would accumulate more multilateral debt than in the data.

An offer states the value of the restructured private debt, $W_p$. The renegotiation ends once both parties agree on a settlement offer. Otherwise, the borrower stays in autarky and the renegotiation resumes next period. Formally,

$$\overline{V}^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = \phi\Omega^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_{l,p}^{RP}) + (1-\phi)\Omega^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_{b,p}^{RP}).$$

$\Omega^{RP}(\cdot)$ is the value derived from a specific offer and $W_{l,p}^{RP}$ and $W_{b,p}^{RP}$ represent the offer made by the private lenders and the borrower, respectively. As the borrower can always decide not to propose or to decline a specific offer $W_p$,

$$\Omega^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_p) = \max\left\{\overline{v}^{DP}(z, \epsilon_{\mathcal{J}+1}, b_m^i, b_p^i), \overline{V}^{EP}(z, \boldsymbol{\epsilon}, b_m^i, W_p)\right\},$$

where $\overline{v}^{DP}(\cdot)$ is the value of remaining in autarky with $y^D(z)$ instead of $y^{DP}(z)$ and $V^{EP}(\cdot, W_p)$ is the value of exiting the renegotiation with a restructured private debt of value $W_p$. This defines a policy function $\overline{A}^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_p)$ which takes value one if $\overline{V}^{EP}(z, \boldsymbol{\epsilon}, b_m^i, W_p) \geq \overline{v}^{DP}(z, \epsilon_{\mathcal{J}+1}, b_m^i, b_p^i)$ and zero otherwise. The value upon restructuring is given by

$$\begin{aligned}\overline{V}^{EP}(z, \boldsymbol{\epsilon}, b_m^i, W_p) = \max_j \ & \left\{u(y(z) + \tau - \varpi(b_m^j, b_p^j) + [1-\delta+\delta\kappa]b_m^i) + \epsilon_j + \beta\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\overline{V}(z', \boldsymbol{\epsilon}', b_m^j, b_p^j)\right\} \\ \text{s.t.} \quad & \tau = \overline{q}_p(z, b_m^j, b_p^j)(-b_p^j) - W_p \geq 0, \\ & b_m^j = \delta b_m^i.\end{aligned}$$

During the restructuring, the borrower repays the value of the restructured debt, $W_p$, and gets rid of the output penalty. As in Dvorkin et al. (2021), the value of restructured debt has to be financed by new debt issuance (i.e. $\tau \geq 0$). More importantly, the borrower cannot issue multilateral debt yet as it is clearing its private debt arrears in the current period.

Let's now determine the settlement offer. The borrower's offer corresponds the private lenders reservation value

$$W_{b,p}^{RP}(z, b_m^i, b_p^i) = -b_p^i\overline{q}_p^{DP}(z, b_m^i, b_p^i),$$

where $\overline{q}_p^{DP}(\cdot)$ is specified in the next section.[20] On the other hand, the private lenders seek to maximize the recovery value the borrower is willing to accept.

$$W_{l,p}^{RP}(z, b_m^i, b_p^i) = \arg\max\left[\mathbb{E}_{\boldsymbol{\epsilon}}\overline{A}^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_p)W_p + (1 - \mathbb{E}_{\boldsymbol{\epsilon}}\overline{A}^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_p))W_{b,p}^{RP}(z, b_m^i, b_p^i)\right]$$

[20]Since the private lenders receive their reservation value, they always accept the borrower's offer. Nevertheless, the borrower might decide not to propose if it is better off staying in autarky.

$$\text{s.t.} \quad W_p \leq -b_p^i(1-\delta+\delta\kappa+\delta\bar{q}).$$

What is the source of delays in this set-up? The borrower usually defaults in low endowment states with a relatively high level of debt. If the borrower desires to settle at the lowest cost, the least it could pay is $\overline{q}_p^{DP}(z, b_m^i, b_p^i)(-b_p^i)$. To get out of default, it would need to issue new private debt. The problem is that in low endowment states, $\overline{q}_p(z, b_m^i, b_p^i)$ is very close to $\overline{q}_p^{DP}(z, b_m^i, b_p^i)$ due to the persistence of the shocks. Owing to the constraint $\tau \geq 0$, the borrower should issue a new level of debt similar to the one it just defaulted on to settle. As a result, it runs the risk of falling into default once again next period. It is then optimal for the borrower to wait that the endowment state improves and that $\overline{q}_p(z, b_m^i, b_p^i)$ recovers in order to settle. Notice that it is also optimal for the private lenders to wait. When the default risk is high, the recovery value is very low. However, as the default risk diminishes, the private lenders can recover more.

### 5.2.2 Full default

The renegotiation after a *full* default is a tripartite renegotiation. To simplify this complex interaction, I assume the following. First, coordination failures between the multilateral and the private lenders are governed by an exogenous probability $\alpha$. Second, the borrower renegotiates with each of the two types of lender separately and the multilateral lender requests full repayment. Third, a settlement occurs with the agreement of all parties. Given this, the value under renegotiation is given by

$$\overline{V}^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = (1-\alpha)\overline{v}^{DF}(z, \epsilon_{\mathcal{J}+2}, b_m^i, b_p^i) + \alpha\overline{v}^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i).$$

where $\overline{v}^{DF}(\cdot)$ is the value of remaining in autarky with $y^D(z)$ instead of $y^{DF}(z)$. The probability $\alpha$ reflects the capacity of the multilateral and the private lenders to coordinate. If $\alpha = 1$ there is no coordination failure. Miscoordination prevents any settlement. In renegotiation,

$$\overline{v}^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = \phi\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_{l,m}^{RF} + W_{l,p}^{RF}) + (1-\phi)\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_{b,m}^{RF} + W_{b,p}^{RF}).$$

$W_{b,i}^{RF}$ represents the offer made by the borrower for the debt type $i \in \{m, p\}$. $W_{l,m}^{RF}$ and $W_{l,p}^{RF}$ represent the offer made by the multilateral and private lenders, respectively. The value of a specific offer $W_m + W_p$ is

$$\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_m + W_p) = \max\left\{\overline{v}^{DF}(z, \epsilon_{\mathcal{J}+2}, b_m^i, b_p^i), \overline{V}^{EF}(z, \boldsymbol{\epsilon}, W_m + W_p)\right\}.$$

This gives the policy function $\overline{A}^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_m + W_p)$. The value under restructuring is

$$\overline{V}^{EF}(z, \boldsymbol{\epsilon}, W_m + W_p) = \max_j \left\{ u(y(z) + \tau - \varpi(b_m^j, b_p^j)) + \epsilon_j + \beta \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} \overline{V}(z', \boldsymbol{\epsilon}', b_m^j, b_p^j) \right\}$$

$$\text{s.t.} \quad \tau = \bar{q}_p(z, b_m^j, b_p^j)(-b_p^j) - (W_m + W_p) \geq 0,$$

$$b_m^j = 0.$$

As before, upon restructuring, the borrower repays the value of the restructured debt, gets rid of the output penalty and cannot issue multilateral debt.

Given that the multilateral lender requests full repayment, $W_{l,m}^{RF}(z, b_m^i, b_p^i) = W_{b,m}^{RF}(z, b_m^i, b_p^i) = -b_m^i(1 - \delta + \delta\kappa + \delta\bar{q})\Psi$ where $\Psi \geq 1$ captures the accumulation of arrears.[21] However, for the private debt, $W_{b,p}^{RF}(z, b_m^i, b_p^i) = -b_p^i \bar{q}_p^{DF}(z, b_m^i, b_p^i) < -b_p^i(1 - \delta + \delta\kappa + \delta\bar{q})$ and

$$W_{l,p}^{RF}(z, b_m^i, b_p^i) = \arg\max \Big[ \mathbb{E}_{\boldsymbol{\epsilon}} \overline{A}^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_m + W_p) W_p + (1 - \mathbb{E}_{\boldsymbol{\epsilon}} \overline{A}^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_m + W_p)) W_{b,p}^{RF}(z, b_m^i, b_p^i) \Big]$$

$$\text{s.t.} \quad W_p \leq -b_p^i(1 - \delta + \delta\kappa + \delta\bar{q}) \text{ and } W_m = -b_m^i(1 - \delta + \delta\kappa + \delta\bar{q})\Psi.$$

The multilateral and private lenders have distinct objective functions. The former only seeks full repayment, while the latter seek the borrower's acceptance. This implies that the private lenders are subordinated as they receive what is left after the repayment of multilateral debt.

How is this setting supposed to generate additional delay? First, coordination failures lead to longer renegotiations. Second, the borrower must wait to have the *ability* – before the *willingness* – to repay $(-b_m^i)(1 - \delta + \delta\kappa + \delta\bar{q})\Psi$. For this, it needs that $\bar{q}_p(z, b_m^i, b_p^i)$ sufficiently improves which happens when the endowment is high enough. In that logic, if the borrower could offer less than full repayment, renegotiations would be shorter.

How is this setting supposed to generate larger private lenders losses? In this model, additional delays are associated with higher recovery values (i.e. lower haircuts). For a given level of debt, the higher is $y(z)$, the higher is $W_p$ due to the lower default risk. Nevertheless, the restriction on multilateral debt issuance and the full repayment of the multilateral lender counterbalance this effect. A larger level of multilateral debt directly implies a larger repayment upon restructuring which reduces $\overline{V}^{EF}(\cdot)$ and therefore reduces $\overline{A}^{RF}(\cdot)$ which then reduces $W_{l,p}^{RF}(\cdot)$ and $W_{b,p}^{RF}(\cdot)$.

[21] $\Psi$ is invariant to the default duration. Otherwise the accumulation of arrears would incentive the borrower to settle more quickly. Moreover, with full repayment and duration-dependent arrear accumulation as in Asonuma and Trebesch (2016), the multilateral debt would simply trade at the risk-free rate.

## 5.3 Prices and bond portfolio

The price of one unit of bond can be separated into two parts: the return when the borrower repays and the recovery value when the borrower defaults.

$$\begin{aligned}\overline{q}_p(z,b_m^j,b_p^j) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\Big[&\big(1-\overline{D}^{DP}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)-\overline{D}^{DF}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\big)\times\\&\big(1-\delta+\delta\kappa+\delta\overline{q}_p(z',\overline{\boldsymbol{H}}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j))\big)+\\&\overline{D}^{DP}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\overline{q}_p^{DP}(z',b_m^j,b_p^j)+\overline{D}^{DF}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\overline{q}_p^{DF}(z',b_m^j,b_p^j)\Big].\end{aligned}$$

If the borrower decides to repay, the private lenders receive the fraction of bond maturing, $1-\delta$, the coupon for the share of debt that is rolled-over, $\delta\kappa$, and the value of the outstanding debt in the next period, $\delta\overline{q}_p(z',\overline{\boldsymbol{H}}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j))$. The recovery value upon *partial* default is

$$\begin{aligned}\overline{q}_p^{DP}(z,b_m^i,b_p^i) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\big[&(1-\phi\overline{A}^{RP}(z',\boldsymbol{\epsilon}',\delta b_m^i,b_p^i,W_{l,p}^{RP}))\overline{q}_p^{DP}(z',\delta b_m^i,b_p^i)+\\&\phi\overline{A}^{RP}(z',\boldsymbol{\epsilon}',\delta b_m^i,b_p^i,W_{l,p}^{RP})\frac{W_{l,p}^{RP}(z',\delta b_m^i,b_p^i)}{-b_p^i}\big].\end{aligned}$$

If the private lenders propose and the borrower accepts the offer, then the recovery value per unit of bond is $\frac{1}{-b_p^i}W_{l,p}^{RP}(z',\delta b_m^i,b_p^i)$. Conversely, if the borrower proposes, the private lenders receive their outside option, $\overline{q}_p^{DP}(z',\delta b_m^i,b_p^i)$. Finally, if the borrower refuses to settle or does not propose, it does not disburse anything now, but in present value it pays $\overline{q}_p^{DP}(z',\delta b_m^i,b_p^i)$. Similarly, in the case of *full* default,

$$\begin{aligned}\overline{q}_p^{DF}(z,b_m^i,b_p^i) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\big[&(1-\alpha\phi\overline{A}^{RF}(z',\boldsymbol{\epsilon}',b_m^i,b_p^i,W_{l,m}^{RF}+W_{l,p}^{RF}))\overline{q}_p^{DF}(z',b_m^i,b_p^i)+\\&\alpha\phi\overline{A}^{RF}(z',\boldsymbol{\epsilon}',b_m^i,b_p^i,W_{l,m}^{RF}+W_{l,p}^{RF})\frac{W_{l,p}^{RF}(z',b_m^i,b_p^i)}{-b_p^i}\big].\end{aligned}$$

Turning to the multilateral debt, the price of one unit of bond is given by

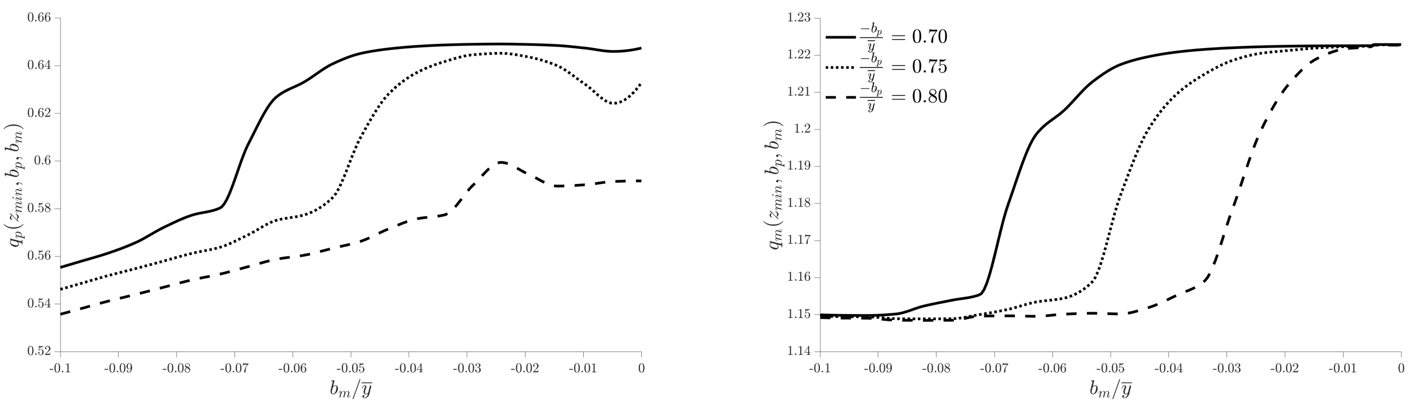
$$\begin{aligned}\overline{q}_m(z,b_m^j,b_p^j) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\Big[&\big(1-\overline{D}^{DF}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\big)\big(1-\delta+\delta\kappa+\delta\overline{q}_m(z',\overline{\boldsymbol{H}}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j))\big)+\\&\overline{D}^{DF}(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\overline{q}_m^{DF}(z',b_m^j,b_p^j)\Big].\end{aligned}$$

Since the multilateral lender is always repaid in full, the recovery value upon *full* default is

$$\begin{aligned}\overline{q}_m^{DF}(z,b_m^i,b_p^i) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\big[&(1-\alpha\overline{A}^{RF}(z',\boldsymbol{\epsilon}',b_m^i,b_p^i,W_{l,m}^{RF}+W_{l,p}^{RF}))\overline{q}_m^{DF}(z',b_m^i,b_p^i)+\\&\alpha\overline{A}^{RF}(z',\boldsymbol{\epsilon}',b_m^i,b_p^i,W_{l,m}^{RF}+W_{l,p}^{RF})(1-\delta+\delta\kappa+\delta\overline{q})\Psi\big].\end{aligned}$$

As $\Psi$ is invariant to the default duration, $\overline{q}_m(\cdot)$ may not equate $\bar{q}$.[22] Thus, the multilateral lender does not necessarily lend at the risk-free rate.

Compared to Section 4, the greater enforcement power of the multilateral lender remains the main ingredient of the model. Hence, a variant of Proposition 2 continues to hold meaning that $\overline{q}_m(z, b_m^j, b_p^j) \geq \overline{q}_p(z, b_m^j, b_p^j)$ in all states. On the one hand, the overall default probability on the multilateral debt is lower than on the private debt owing to the greater output penalty. On the other hand, the multilateral debt continues to be repaid in *partial* default and eventually gets repaid in full after a *full* default.




(a) $q_p$ (b) $q_m$

Figure 3: Bond Prices – Quantitative Model

More importantly, a variant of Proposition 3 also continues to hold meaning that there exists a catalytic finance region. This is because more multilateral debt reduces the probability of a *partial* default given the additional multilateral debt servicing costs in autarky. However, with the introduction of utility shocks, Proposition 1 does not hold anymore as there is always a positive probability of *partial* and *full* defaults. Hence, more multilateral debt effectively reduces the overall default risk if it decreases the probability of a *partial* default without a one-to-one increase in the probability of *full* default.[23]

Figure 3 depicts the bond prices using the calibration in Section 6. Similar to Figure 2, the private bond price has an inverse U shape in $b_m$ and is increasing in $b_p$, whereas the multilateral bond price is increasing in both $b_m$ and $b_p$.

Following the same approach as in Section 4.3, I assume that the bond choices have a continuous and compact support without utility shocks and that the bond prices and the value of repayment are differentiable everywhere. Taking the first-order conditions, the

[22] If $\Psi$ is close to 1, $\overline{q}_m(\cdot) < \bar{q}$. Conversely, if $\Psi$ is sufficiently large, $\overline{q}_m(\cdot) > \bar{q}$.

[23] The recovery value in *partial* default also depends on multilateral debt. However, the effect of more multilateral debt can go both way as both the total indebtedness and the default duration increase. More debt tends to increases haircuts, while a longer default has the opposite effect.

seniority benefit can be formulated as

$$\frac{\frac{\overline{q}_m}{\overline{q}_p}+\frac{\partial\overline{q}_m}{\partial b'_m}\frac{(b'_m-\delta b_m)}{\overline{q}_p}+\frac{\partial\overline{q}_p}{\partial b'_m}\frac{(b'_p-\delta b_p)}{\overline{q}_p}+\frac{\partial\varpi}{\partial b'_m}\frac{1}{\overline{q}_p}}{1+\frac{\partial\overline{q}_m}{\partial b'_p}\frac{(b'_m-\delta b_m)}{\overline{q}_p}+\frac{\partial\overline{q}_p}{\partial b'_p}\frac{(b'_p-\delta b_p)}{\overline{q}_p}+\frac{\partial\varpi}{\partial b'_p}\frac{1}{\overline{q}_p}}.$$

Except for the issuance cost, the expression is very similar to the one in Section 4.3. The seniority benefit is therefore expected to be the strongest when the risk of a *full* default is the lowest. When the risk of a *full* default is high, more multilateral debt reduces the recovery value of private debt. This effect was absent in the analytical model and weakens the seniority benefit. Regarding the subordination benefit, one gets the following expression

$$\frac{\mathbb{E}^R_{z'|z}\left[u_c(c')\right]\mathbb{E}^R_{z'|z}\left[1-\delta+\delta\kappa+\delta\overline{q}'_m\right]+\delta\,\mathrm{cov}^R(u_c(c'),\overline{q}'_m)+\mathbb{E}^{DP}_{z'|z}\left[u_c(\ddot{c}')[1-\delta+\delta\kappa]\right]}{\mathbb{E}^R_{z'|z}\left[u_c(c')\right]\mathbb{E}^R_{z'|z}\left[1-\delta+\delta\kappa+\delta\overline{q}'_p\right]+\delta\,\mathrm{cov}^R(u_c(c'),\overline{q}'_p)},$$

where $\overline{q}'_j=\overline{q}_j(z',\overline{\boldsymbol{H}}(z',b'_m,b'_p))$ for $j\in\{m,p\}$ denotes the bond price next period, $\ddot{c}'=y^{DP}(z')+[1-\delta+\delta\kappa]b'_m$ is the consumption in *partial* default and $\mathrm{cov}^R(\cdot)$ denotes the covariance in repayment. This covariance term was absent in Section 4.3 and comes from dilution which reduces the future debt burden. Due to the high recovery value, $\overline{q}'_m$ remains relatively close to $\bar{q}$, while $\overline{q}'_p$ can get closer to 0. This means that in low endowment states, the price of private debt tomorrow, $\overline{q}'_p$, can decrease relatively more when the prospective consumption is low. That is $\mathrm{cov}^R(u_c(c'),\overline{q}'_p)\leq\mathrm{cov}^R(u_c(c'),\overline{q}'_m)<0$. This reinforces the subordination benefit.

Note that the solution may not be interior as the constraint $\mathcal{A}$ can bind. As a result, the seniority benefit is equal to or greater than the subordination benefit in equilibrium.

# 6 Quantitative Analysis

This section first presents the calibration of the model and evaluates its goodness of fit with respect to targeted and untargeted moments. It continues with a study of the default dynamic and finishes with counterfactual analyses on the seniority structure.

## 6.1 Calibration and model evaluation

The model is solved using numerical methods presented in Appendix D and is calibrated in the following way. Some parameters are borrowed from the literature, some are estimated directly from the data and the remainders are selected to match some specific moments.

I calibrate the model to Argentina with a yearly frequency. Table 2 summarizes the main parameters of the model. The utility function takes the constant relative risk aversion (CRRA) form $u(c) = \frac{c^{1-\varrho}}{1-\varrho}$ with the standard value of $\varrho = 2$ in the literature. The risk-free rate is 4.2% to match the average real 10-year US Treasury bonds yield reported by Dvorkin et al. (2021). Finally, the stochastic endowment follows a log-normal AR(1) process $\log y_t = \rho \log y_{t-1} + \varepsilon_t$ with $\varepsilon \sim N(0, \sigma_\varepsilon^2)$. Based on the estimation of Arellano (2008) for Argentina, $\rho = 0.945$ and $\sigma_\varepsilon = 0.025$. The stochastic endowment is discretized into a 7-state Markov chain following Tauchen (1986).

Table 2: Parameters

| Parameter | Value | Description | Targeted Moment | Data | Model |
|---|---|---|---|---|---|
| A. Literature | | | | | |
| $\varrho$ | 2 | Risk aversion | | | |
| B. Data | | | | | |
| $r$ | 0.042 | Risk-free rate | Average 10-year US real Treasury yield | | |
| $\delta$ | 0.9 | Average maturity | Average maturity Argentina | | |
| $\kappa$ | 0.12 | Coupon payment | Average coupon rate Argentina | | |
| $\rho$ | 0.945 | Shock persistence | Real GDP Argentina | | |
| $\sigma_\epsilon$ | 0.025 | Shock standard deviation | | | |
| C. Model | | | | | |
| $\beta$ | 0.9445 | Discount factor | Debt-to-GDP ratio (%) | 48.26 | 48.59 |
| $\mathcal{A}$ | -0.145 | Borrowing limit | Multilateral-debt-to-GDP ratio (%) | 7.52 | 7.52 |
| $\phi$ | 0.55 | Bargaining power | Average SZ haircut (%) | 37.52 | 37.41 |
| $\psi$ | 0.8745 | Continuation default cost | Average default duration (year) | 3.65 | 3.75 |
| $\iota^{DP}$ | 0.89 | Entry *partial* default cost | Overall default rate (%) | 3.00 | 2.84 |
| $\iota^{DF}$ | 0.855 | Entry *full* default cost | *Full* default share (%) | 17.65 | 17.54 |
| $a_1$ | $10^{-9}$ | Issuance cost (intercept) | Average issuance costs (%) | 0.20 | 0.11 |
| $a_2$ | 26.5 | Issuance cost (slope) | Debt increase before default (p.p.) | 22.00 | 18.07 |
| $\Psi$ | 1.3 | Arrears accumulation | Average private over multilateral spreads | 25.68 | 26.32 |
| $\alpha$ | 0.6 | Coordination probability | Volatility of consumption relative to output | 1.17 | 1.15 |
| $\omega$ | 0.012 | Utility shock variance | Standard deviation debt-to-GDP ratio | 8.00 | 9.64 |
| $\upsilon$ | 0.205 | Utility shock correlation | Standard deviation default duration | 4.73 | 5.81 |

Based on Chatterjee and Eyigungor (2012), $\kappa = 0.12$ to replicate the average coupon rate of Argentina. I set $\delta = 0.9$ to match the average maturity which I estimate as the ratio of the external debt over the external debt service. I subsequently select $\beta = 0.9445$ to match the average external debt-to-GDP ratio of Argentina between 1985 and 2014. Similarly, $\mathcal{A} = -0.145$ to match the average multilateral debt-to-GDP ratio of Argentina in the same time interval.[24] Moreover, the issuance cost is $\varpi(b'_p, b'_p) = a_1 \exp\left(a_2 |b'_p + b'_m|\right) - a_1$. The parameter $a_1 = 10^{-9}$ is calibrated to replicate a median issuance cost of 0.2% following the conservative estimates of Joffe (2015).[25] The parameter $a_2 = 26.5$ is calibrated to replicate a 22 percentage point (p.p.) increase in the debt ratio prior to default following Mendoza

[24]Between 1985 and 2014 the average debt ratios of Argentina are close to the ones of the median country in the sample used in Section 2 which amount 44.05% in total and 8.44% for multilateral debt. If one starts in 1970, the average ratios of Argentina are lower than these.

[25]The issuance cost is computed as a share of the face value, i.e. $\frac{\varpi(b'_p, b'_p)}{-(q_p(z,b'_p,b'_p)b'_p + q_m(z,b'_p,b'_p)b'_m)}$.

and Yue (2012).

Regarding the output penalty, when the borrower enters a *partial* default, its endowment is given by $y^{DP}(z) = \iota^{DP} y^D(z)$, while if it enters a *full* default, it receives $y^{DF}(z) = \iota^{DF} y^D(z)$. If the borrower stays in default its endowment is given by $y^D(z) = \min\{y(z), \psi \mathbb{E}[y(z)]\}$ following Arellano (2008). I calibrate $\iota^{DP} = 0.89$ to match a 3% default rate, $\iota^{DF} = 0.855$ to match the share of *full* defaults and $\psi = 0.8745$ to match the average default duration. In addition, I select the value of the bargaining power $\phi = 0.55$ to match the average SZ haircut. The value is the same as in Dvorkin et al. (2021). The coordination probability $\alpha = 0.6$ is set to match the volatility of consumption relative to output. The parameter governing the accumulation of multilateral debt arrears $\Psi = 1.3$ is set to replicate the ratio between the average interest rate spreads of the private and the multilateral debt.

Finally, I calibrate the variance and the correlation parameters of the utility shocks to match the standard deviation of the debt-to-GDP ratio and the standard deviation of the duration, respectively.

Table 3: Empirical Facts

| | Data | Model | | Data | Model |
|---|---|---|---|---|---|
| Fact I: Multilateral debt share (%) | 14.77 | 16.21 | Fact IV: *Full* default share (%) | 17.65 | 17.54 |
| Fact II: Interest rate spread (%) | | | Fact V: Default duration (year) | | |
| Private debt | 14.43 | 1.53 | Overall | 3.65 | 3.75 |
| Multilateral debt | 0.56 | 0.06 | *Full* default | 8.55 | 9.68 |
| Ratio private over multilateral | 25.68 | 26.32 | *Partial* default | 2.60 | 2.46 |
| Fact III: Multilateral debt (% $y$) | | | Fact VI: Private lenders' haircut (%) | | |
| Outside default | 7.11 | 6.92 | Overall | 37.52 | 37.41 |
| At default Start | 8.22 | 9.75 | *Full* default | 58.99 | 57.78 |
| Inside default | 15.26 | 12.47 | *Partial* default | 32.92 | 33.25 |

*Note*: In the data, the multilateral debt share is the ratio of multilateral debt over the total external debt for Argentina between 1985 and 2014. The interest rate spread is the EMBI+ spread for Argentina between 1970 and 2022. The remaining statistics are the ones reported in Table 1. In the model, one period corresponds to a year and haircuts are computed as $1 - \frac{W(1+r)}{-b_p(1-\delta+\delta\kappa+\delta\bar{q})}$. The multilateral-debt-to-GDP ratio includes the accumulation of arrears $\Psi$ in *full* defaults.

Table 3 summarizes the facts presented in Section 2. Facts I, II and IV are directly targeted, the others are not. Consistent with Fact III, the model generates a higher level of multilateral debt both before and during the default. The latter effect comes from the arrear accumulation $\Psi$ in *full* default.[26] The increase at the default start also comes from a greater multilateral debt issuance prior to a *full* default as shown in the next subsection. Besides this, the model yields haircuts and default durations in line with Facts V and VI.

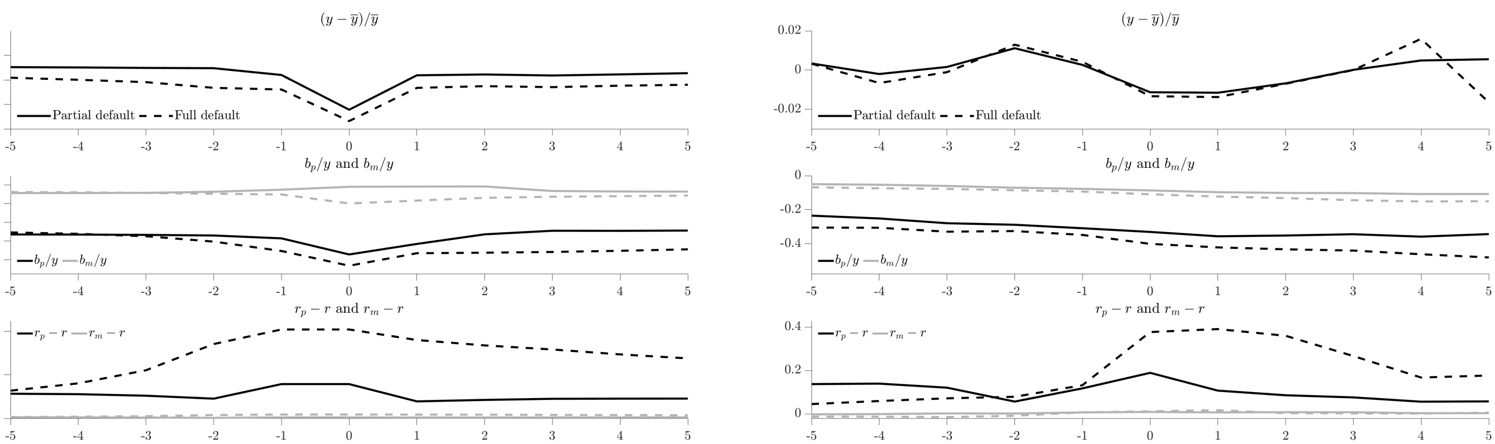
[26] New lending could also explain the increase of multilateral debt during defaults as in Arellano and Barreto (2024). I abstract from this channel here.

In the data, a *full* default lasts 6.0 more years and the associated haircut is 26.1 percentage points higher on average. In the model, it lasts 7.2 more years than a *partial* default and the associated haircut is 24.5 percentage points higher on average. Note that with $1-\alpha = 0.4$, miscoordination in *full* defaults is mild as it corresponds to 2.5 years over a total of 9.7 years on average.[27]

Regarding the interest rate spread, the model can replicate the ratio between the two average spreads but cannot replicate the level of each spread. The same holds true for the standard deviation. In the data, the standard deviation of the multilateral and private debt spreads are 1.26 and 15.99, respectively. In the model, it is 0.002 and 0.029, respectively. In comparison to previous studies, Dvorkin et al. (2021) report an average private debt spread of 1.01%. Chatterjee and Eyigungor (2012) report an average spread of 8.15% with a standard deviation of 4.43. The better fit can be explained by a recovery value fixed to zero and the use of a quadratic default penalty function.

## 6.2 Default dynamic

In what follows, I analyze the dynamic of defaults in the model. I first construct an event analysis in a window of five years before and after a default. I subsequently analyze selected statistics in the two types of default.




(a) Model (b) Data

*Note*: The figure depicts the evolution of endowment, debt and spreads around *partial* and *full* defaults. Period 0 corresponds to the occurrence of default. In the model, averages come from simulation over 2000 economies for 600 periods where the initial 200 periods are discarded. The variable $\bar{y}$ corresponds to the average output. In the data, averages come from the sample used in Section 2. The variable $(y-\overline{y})/\overline{y}$ corresponds to the deviation from the GDP trend using the HP filter with a smoothing parameter of 6.25. The variable $b_m$ corresponds to the multilateral debt and $b_p$ to the remaining part of total sovereign debt.

Figure 4: Event Analysis

[27]This is the direct effect of miscoordination on the default duration. There is also an indirect effect as $\alpha$ impacts the value of a *full* default.

To construct the event analysis, I simulate 2000 economies for 600 periods. To make sure that the initial conditions do not matter, I discard the first 200 periods. I then identify the five periods preceding and succeeding a default and take the average over the simulated panel. I discriminate between *partial* and *full* defaults both in the model and in the data.

Figure 4a depicts the event analysis for some selected variables in the model. Period 0 corresponds to the default start. The solid line relates to a *partial* default, while the dashed line corresponds to a *full* default. For the debt-related statistics, the black lines correspond to the private debt and the grey lines to the multilateral debt. *Partial* defaults arise when the output drops and the private indebtedness is high. The interest rate spread of private debt reacts more than the spread of multilateral debt. *Full* defaults are precedented by a larger output contraction and a greater accumulation of debt than in a *partial* default. The multilateral indebtedness increases, whereas it decreases in a *partial* default. This is consistent with the analysis in Section 4.3. The interest rate spread of private debt reacts the most given the subordination. The interest rate spread of multilateral debt remains flat.

Figure 4b depicts the event analysis for the aforementioned variables in the data. As in the model, both defaults arise after a sudden and sharp reduction in output when the level of indebtedness is large. In addition, the interest rate spread of private bond reacts the most in a *full* default, whereas the interest rate spread of multilateral debt remains flat. However, two points differ from the model predictions. First, the difference in output at which countries enter a *partial* or a *full* default is smaller in the data. Second, multilateral debt remains stable before a *partial* default, while it decreases in the model.

Table 4: Default Statistics

| | | Average duration (year) | | Average haircut (%) | |
|---|---|---|---|---|---|
| Private debt (% $\overline{y}$) | Multilateral debt (% $\overline{y}$) | *Partial* default | *Full* default | *Partial* default | *Full* default |
| 60.0 | 15.0 | 4.9 | 17.8 | 23.6 | 40.9 |
| 60.0 | 0.0 | 5.8 | 17.7 | 21.4 | 24.8 |
| 5.0 | 15.0 | 1.5 | 17.8 | 5.0 | 16.3 |
| 5.0 | 0.0 | 1.3 | 2.2 | 4.3 | 8.9 |

| Share of time (%) | *Partial* default | *Full* default | $b'_m = \mathcal{A}$ | Catalytic finance region |
|---|---|---|---|---|
| Total | 8.6 | 5.8 | 4.1 | 1.4 |
| Where $y(z) < \overline{y}$ (%) | 8.6 | 5.8 | 2.9 | 1.4 |
| Where $b_m/y(z) < -0.075$ (%) | 0.1 | 5.7 | 2.4 | 0.9 |
| Where $b_p/y(z) < -0.485$ (%) | 8.6 | 5.8 | 1.6 | 0.9 |

*Note*: The first part of the table depicts the average haircut and duration for *partial* and *full* defaults. The initial endowment is $z_{min}$. The second part of the table depicts the share of time spent in different parts of the state space. The catalytic finance region is defined as the part of the state space in which the private bond price is decreasing in $b_m$.

Since the borrower enters in a *full* default with a greater indebtedness and a lower endowment than in a *partial* default, it is important to compare the haircut and the default duration for similar levels of debt and output. Table 4 depicts such statistics starting at $z_{min}$. A *full* default is always related to a longer average duration and a larger haircut than a *partial* default. The wedge is more pronounced when the multilateral debt is high.

Table 4 also depicts the share of time spent in different regions of the state space. Overall, the borrower spends 14% of its time in default. As highlighted previously, defaults arise when $y < \overline{y}$ and indebtedness is high. More importantly, the borrower spends less than 2% of its time in the catalytic finance region. In comparison, it more frequently defaults or exhausts its multilateral borrowing limit. The catalytic finance region seems mostly beneficial when $y < \overline{y}$ and indebtedness is high – i.e. total debt is 57.9% and multilateral debt is 8.6% of GDP on average. In this region, the interest rate spread on private debt is 1.27%, while it is 2.32% when $y < \overline{y}$. Hence, the reduction in spread is of 45.4% on average. When the borrower leaves the catalytic finance region, the effect on the spread declines over time and completely vanishes after 3 years. Hence, the positive catalytic effect of multilateral debt is strong but short lived. Hatchondo et al. (2017) find similar results as they report a reduction in the private interest rate spread of 64.3% when endowment is low which then disappears after 4 years.

### 6.3 Multilateral debt and seniority

I assess the welfare related to multilateral debt. For this I consider the model without multilateral debt and two alternative seniority regimes: full enforceability and *pari passu*. I subsequently analyze which assumptions behind the *de facto* seniority explain the empirical facts. Table 5 depicts the borrower's consumption-equivalent welfare gains with respect to the benchmark model and Table 6 presents selected moments in each specification of the model.

I first consider the case in which the borrower can only issue private debt – i.e. $\mathcal{A} = 0$. Similar to Hatchondo et al. (2017), the borrower highly values the use of a near-risk-free bond like the multilateral debt. The model without multilateral debt is associated with mostly welfare losses. The only exception is at $z_{min}$ as the borrower avoids a *full* default. Instead it can enter in a *partial* default in which there is no multilateral debt service and the output penalty is lower than in a *full* default.

Second, I assume that $\iota^{DF} = 0$ which, given the form of the utility function, implies no *full* default anymore. The model is close to the one of Boz (2011) and Fink and Scholl (2016) as there is full enforceability of the multilateral debt. Compared to the benchmark model, one observes only welfare losses which are particularly large in regions of debt crises

Table 5: Welfare Gains Relative to Benchmark

| Endowment state | Private debt ($\% \, \overline{y}$) | Multilateral debt ($\% \, \overline{y}$) | Welfare gains (%) $\mathcal{A}=0$ | Welfare gains (%) $\iota^{DF}=0$ | Welfare gains (%) *pari passu* |
|---|---|---|---|---|---|
| $z_{min}$ | 60.0 | 15.0 | - | -1.31 | 0.18 |
| | 60.0 | 0.0 | 0.57 | -0.00 | -0.11 |
| | 0.0 | 15.0 | - | -0.29 | -0.17 |
| | 0.0 | 0.0 | 0.03 | -0.25 | -0.49 |
| $z_{max}$ | 60.0 | 15.0 | - | -0.26 | -0.28 |
| | 60.0 | 0.0 | -0.30 | -0.26 | -0.28 |
| | 0.0 | 15.0 | - | -0.21 | -0.23 |
| | 0.0 | 0.0 | -0.23 | -0.21 | -0.23 |
| average | 60.0 | 15.0 | - | -0.48 | -0.08 |
| | 60.0 | 0.0 | -0.25 | -0.21 | -0.27 |
| | 0.0 | 15.0 | - | -0.18 | -0.23 |
| | 0.0 | 0.0 | -0.22 | -0.18 | -0.24 |

*Note*: Welfare gains are computed as $\left[\frac{\overline{V}_a(z,\boldsymbol{\epsilon},b_m^i,b_p^i)}{\overline{V}_b(z,\boldsymbol{\epsilon},b_m^i,b_p^i)}\right]^{\frac{1}{1-\varrho}} - 1$ where $\overline{V}_b(\cdot)$ and $\overline{V}_a(\cdot)$ denote the borrower's value in the benchmark and the alternative model, respectively.

– i.e. low endowment states with a large level of debt. Losses come from the incapacity of the borrower to repudiate its entire debt. The borrower can only enter in *partial* default in which it continues to service the multilateral debt.

Third, I introduce a *pari passu* clause between the multilateral and the private lenders. The two types of lenders make a joint offer $X$ for the entire defaulted debt. The borrower's offer is given by $X_b^{RF}(z,b_m^i,b_p^i) = -b_p^i q_p^{DF}(z,b_m^i,b_p^i) - b_m^i q_m^{DF}(z,b_m^i,b_p^i)$ and the joint offer of the multilateral and private lenders is

$$X_l^{RF}(z,\boldsymbol{\epsilon},b_m^i,b_p^i) = \arg\max \left[\mathbb{E}_{\boldsymbol{\epsilon}} A^{RF}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,X)X + (1-\mathbb{E}_{\boldsymbol{\epsilon}} A^{RF}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,X))X_b^{RF}(z,b_m^i,b_p^i)\right]$$
$$\text{s.t.} \quad X \leq -(b_p^i + b_m^i)(1-\delta+\delta\kappa+\delta\bar{q}).$$

For a given offer $X$, the transfer upon restructuring is $\tau = q_p(z,b_m^j,b_p^j)(-b_p^j) - X \geq 0$ where the private lenders get $\frac{b_p^j}{b_p^j+b_m^j}X$ and the multilateral lender the remaining part. There is no arrear accumulation on multilateral debt. However, the greater enforcement power of the multilateral debt remains since $\iota^{DF} < \iota^{DP}$.

Compared to the benchmark model, I find welfare losses under a *pari passu* clause. The only exception is at $z_{min}$ with a large level of indebtedness. This is because a *pari passu* clause eases the renegotiation process under a *full* default. The welfare losses come from the fact that the multilateral debt loses part of its property of a last-resort fund. As one can see

Table 6: Alternative Specifications

| | Benchmark | $\mathcal{A}=0$ | $\iota^{DF}=0$ | *pari passu* | $\iota^{DF}=\iota^{DP}$ |
|---|---|---|---|---|---|
| Default duration (year) | | | | | |
| Overall | 3.75 | 1.39 | 3.67 | 3.59 | 6.33 |
| *Full* default | 9.68 | - | - | 4.29 | 6.55 |
| *Partial* default | 2.46 | 1.39 | 3.67 | 3.22 | 1.51 |
| Private lenders' haircut (%) | | | | | |
| Overall | 37.41 | 40.50 | 37.61 | 40.22 | 49.50 |
| *Full* default | 57.78 | - | - | 44.24 | 49.88 |
| *Partial* default | 33.25 | 40.50 | 37.61 | 38.37 | 40.93 |
| Debt (% of $y$) | | | | | |
| Overall | 48.59 | 45.66 | 47.56 | 46.18 | 47.36 |
| Multilateral (total) | 7.52 | 0.00 | 7.41 | 7.61 | 8.25 |
| Multilateral (at default start) | 9.75 | 0.00 | 1.05 | 8.28 | 7.60 |
| Multilateral (inside default) | 12.47 | 0.00 | 1.05 | 8.28 | 9.36 |
| Interest rate spread (%) | | | | | |
| Private | 1.53 | 1.81 | 1.37 | 1.50 | 1.35 |
| Multilateral | 0.06 | - | 0.00 | 0.71 | -0.05 |
| Share *full* default (%) | 17.54 | 0.00 | - | 34.19 | 95.12 |
| Default rate (%) | 2.84 | 4.60 | 2.51 | 2.74 | 1.60 |

in Table 6, the interest rate spread of multilateral debt is more than 10 times higher than in the benchmark model.

All in all, the *de facto* seniority seems to be beneficial for the borrower. Except in a few states, the borrower is better off than with full enforceability of multilateral debt or a *pari passu* clause. The former is certainly too strict and does not allow for full debt default, while the latter limits the multilateral debt's capacity of being a last-resort source of funding.

In the benchmark model, the *de facto* seniority of multilateral lenders come from two assumptions: $\iota^{DF} < \iota^{DP}$ and the full repayment of defaulted multilateral debt. As shown in Table 6, with a *pari passu* clause, *partial* and *full* defaults have similar average duration and haircut. Moreover, despite similar debt ratio and default rate, one observes a larger interest rate spread of multilateral debt compared to the benchmark case. In that logic, the multilateral debt increases less before a default. There is also no increase during the default given the absence of arrear accumulation. Hence, the full repayment of the multilateral lender is a prerequisite to safeguard lending at preferential rates. It is also at the source of larger haircuts and longer durations in *full* defaults. Besides this, when $\iota^{DF} = \iota^{DP} = 0.87$, *partial* defaults become extremely rare. Despite this, both the haircut and the default duration remain higher in a *full* default than in a *partial* default.[28]

[28]The negative interest rate spread of multilateral debt comes from the fact that $\Psi = 1.3$ is too high under the reduced *full* default duration. Roughly speaking one has $(1+r)^{6.3} < 1.3 < (1+r)^{9.7}$. With

As a result, the full repayment of multilateral lenders is mainly behind Facts II, III, V and VI, while the output penalty explains Fact IV. Finally, $\mathcal{A}$ takes care of Fact I.

# 7 Conclusion

This paper analyzes the multilateral debt both empirically and theoretically. Multilateral lenders are an important part of sovereign lending especially in the vicinity of a default and lend at rates close to the risk-free rate. Defaults involving such lenders are infrequent, last relatively longer and are associated with greater private lenders haircuts.

To rationalize these findings, I develop a model with multilateral and private lenders. The key assumption is that the multilateral lender has a greater enforcement power which emanates from a larger output penalty and a tough renegotiation upon default.

The main outcome of the model is that the private bond price is non-monotonic in the multilateral debt. This comes from the distinction between *partial* and *full* default. The latter is unattractive when the level of multilateral debt is small owing to the greater output penalty and the though renegotiation with the multilateral lender. The value of a *partial* default is however decreasing in multilateral indebtedness due to the debt servicing costs. As a result, the private bond price increases with additional multilateral debt. The opposite holds when the multilateral debt is large. Hence, in small amount, official multilateral debt has a positive catalytic effect. Quantitatively, this effect is strong but short lived.

The model quantitatively matches the empirical regularities relating to the multilateral lending, the default durations and the private lenders losses. The though renegotiation inspired from the practice of the IMF and the WB is behind most of the model's dynamic. It ensures that multilateral lenders can lend at preferential rates even under high default risks. It also explains the larger haircut and the longer default duration in a *full* default. I find that the borrower values the use of official multilateral debt and would not necessarily prefer other seniority regimes.

My analysis abstracts from the Paris Club which is another major actor in the sovereign debt market. Very few studies analyze this entity which does not properly enjoy a preferential status but largely impacts the private lenders haircuts and imposes a comparability of treatment among lenders. I leave this inquiry for future work.

$\iota^{DF} = \iota^{DP} = 0.87$ and $\Psi = 1$, the share of *full* default is 98.73%. Finally, $\iota^{DF} = \iota^{DP} = 0.87$ combined with a *pari passu* clause make private and multilateral debt perfect substitutes.

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# Appendix

## A Data

This section presents the different sources of data used in the empirical analysis and for the calibration of the model. Table A.1 depicts the sample of countries and default episodes used in the analysis.

Table A.1: Sample

| Country | Default Start | Default End | Duration | SZ Haircut | With Multilateral Lenders | Country | Default Start | Default End | Duration | SZ Haircut | With Multilateral Lenders |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 01.11.1991 | 31.08.1995 | 3.8 | 80.4 | No | Morocco | 22.10.1985 | 23.09.1987 | 2.0 | 21.3 | No |
| Algeria | 01.10.1990 | 01.03.1992 | 1.5 | 8.7 | No | Morocco | 01.02.1989 | 01.09.1990 | 1.7 | 40.3 | No |
| Algeria | 01.12.1993 | 17.07.1996 | 2.7 | 23.5 | No | Mozambique | 01.06.1983 | 27.12.1991 | 8.6 | 90.0 | No |
| Argentina | 01.07.1982 | 27.08.1985 | 3.2 | 30.3 | No | Mozambique | 01.03.1993 | 01.09.2007 | 14.6 | 91.0 | No |
| Argentina | 01.08.1985 | 21.08.1987 | 2.1 | 21.7 | No | Nicaragua | 01.09.1978 | 01.12.1980 | 2.3 | 26.1 | No |
| Argentina | 01.01.1988 | 07.04.1993 | 5.3 | 32.5 | No | Nicaragua | 01.06.1981 | 01.12.1981 | 0.6 | 48.5 | No |
| Argentina | 01.11.2001 | 10.06.2005 | 3.7 | 76.8 | Yes | Nicaragua | 01.06.1982 | 01.03.1982 | -0.2 | 56.3 | No |
| Belize | 02.08.2006 | 20.02.2007 | 0.6 | 23.7 | No | Nicaragua | 01.03.1983 | 01.02.1984 | 1.0 | 41.7 | Yes |
| Belize | 31.08.2012 | 01.03.2013 | 0.7 | 31.5 | No | Nicaragua | 01.04.1985 | 01.11.1995 | 10.7 | 92.0 | Yes |
| Bolivia | 01.09.1980 | 17.03.1988 | 7.6 | 92.7 | Yes | Nicaragua | 01.11.1995 | 01.12.2007 | 12.2 | 95.5 | No |
| Bolivia | 01.04.1988 | 01.04.1993 | 5.1 | 76.5 | Yes | Niger | 01.06.1983 | 09.03.1984 | 0.8 | 37.4 | No |
| Bosnia & Herzegovina | 01.06.1992 | 09.12.1997 | 5.6 | 89.6 | Yes | Niger | 01.06.1984 | 01.04.1986 | 1.9 | 45.8 | No |
| Brazil | 01.12.1982 | 25.02.1983 | 0.3 | -9.8 | No | Niger | 01.06.1986 | 08.03.1991 | 4.8 | 82.0 | No |
| Brazil | 01.01.1983 | 27.01.1984 | 1.1 | 1.7 | No | Nigeria | 01.08.1982 | 01.09.1983 | 1.2 | 1.2 | No |
| Brazil | 01.06.1984 | 05.09.1986 | 2.3 | 19.2 | No | Nigeria | 01.08.1982 | 01.07.1983 | 1.0 | 2.1 | No |
| Brazil | 01.09.1986 | 11.11.1988 | 2.3 | 18.4 | No | Nigeria | 01.10.1983 | 01.04.1984 | 0.6 | -2.8 | No |
| Brazil | 01.06.1989 | 20.11.1992 | 3.5 | 27.0 | No | Nigeria | 01.01.1986 | 23.11.1987 | 1.9 | 19.3 | No |
| Brazil | 01.06.1989 | 15.04.1994 | 4.9 | 29.3 | No | Nigeria | 01.10.1987 | 01.01.1988 | 0.3 | 41.5 | No |
| Bulgaria | 01.03.1990 | 29.06.1994 | 4.3 | 56.3 | No | Nigeria | 01.03.1988 | 01.06.1989 | 1.3 | 30.1 | No |
| Cameroon | 01.06.1985 | 01.08.2003 | 18.3 | 85.5 | No | Nigeria | 01.06.1989 | 20.12.1991 | 2.6 | 40.1 | No |
| Chile | 01.01.1983 | 01.11.1983 | 0.9 | 0.7 | No | Pakistan | 01.07.1998 | 12.12.1999 | 1.5 | 11.6 | No |
| Chile | 01.01.1983 | 25.01.1984 | 1.1 | 8.4 | No | Pakistan | 30.01.1999 | 13.12.1999 | 1.0 | 15.0 | No |
| Chile | 01.08.1984 | 14.04.1986 | 1.8 | 31.7 | No | Panama | 01.11.1984 | 01.10.1985 | 1.0 | 12.0 | No |
| Chile | 01.10.1986 | 17.06.1987 | 0.8 | 14.3 | No | Panama | 01.03.1987 | 01.08.1994 | 7.5 | 15.1 | Yes |
| Chile | 01.04.1990 | 12.12.1990 | 0.8 | 17.0 | No | Panama | 01.03.1987 | 17.04.1996 | 9.2 | 34.9 | Yes |
| Costa Rica | 15.07.1981 | 10.09.1983 | 2.3 | 39.4 | No | Paraguay | 01.01.1986 | 01.07.1993 | 7.6 | 29.2 | No |
| Costa Rica | 01.10.1984 | 27.05.1985 | 0.7 | 35.6 | No | Peru | 01.03.1976 | 01.12.1978 | 2.8 | -7.2 | No |
| Costa Rica | 01.05.1986 | 21.05.1990 | 4.1 | 71.9 | No | Peru | 01.09.1979 | 01.01.1980 | 0.4 | -4.6 | No |
| Croatia | 01.12.1991 | 31.07.1996 | 4.7 | 11.0 | No | Peru | 01.03.1983 | 01.07.1983 | 0.4 | 6.3 | No |
| Cuba | 01.09.1983 | 30.12.1983 | 0.3 | 42.9 | No | Peru | 01.06.1984 | 07.03.1997 | 12.8 | 63.9 | Yes |
| Cuba | 01.01.1984 | 24.12.1984 | 1.0 | 44.2 | No | Philippines | 01.10.1983 | 01.04.1986 | 2.6 | 42.6 | No |
| Cuba | 01.01.1985 | 19.09.1985 | 0.8 | 49.5 | No | Philippines | 01.09.1986 | 01.12.1987 | 1.3 | 15.4 | No |
| Côte d'Ivoire | 01.06.1983 | 01.03.1998 | 14.8 | 62.8 | No | Philippines | 01.07.1988 | 01.02.1990 | 1.7 | 42.8 | No |
| Côte d'Ivoire | 01.03.2000 | 16.04.2010 | 10.2 | 55.2 | Yes | Philippines | 01.07.1990 | 01.12.1992 | 2.5 | 25.4 | No |
| Côte d'Ivoire | 31.01.2011 | 12.11.2012 | 1.9 | 6.1 | No | Poland | 01.03.1981 | 06.04.1982 | 1.2 | 40.6 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1975 | 12.04.1980 | 4.9 | 29.6 | Yes | Poland | 01.01.1982 | 04.11.1982 | 0.9 | 62.9 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.04.1982 | 29.01.1983 | 0.8 | 38.2 | Yes | Poland | 01.12.1982 | 04.11.1983 | 1.0 | 52.5 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.02.1983 | 01.06.1984 | 1.4 | 30.1 | Yes | Poland | 01.12.1983 | 13.07.1984 | 0.7 | 26.9 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.09.1984 | 01.05.1985 | 0.8 | 37.0 | No | Poland | 01.01.1986 | 01.09.1986 | 0.8 | 37.5 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1985 | 01.05.1986 | 1.0 | 35.4 | No | Poland | 01.10.1986 | 20.07.1988 | 1.8 | 24.4 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1986 | 20.05.1987 | 1.0 | 26.8 | No | Poland | 01.08.1988 | 01.07.1989 | 1.0 | 12.0 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1987 | 01.06.1989 | 2.1 | 50.6 | Yes | Poland | 01.10.1989 | 27.10.1994 | 5.1 | 49.0 | No |
| Dominica | 01.07.2003 | 15.06.2004 | 1.0 | 54.0 | No | Rep. Of Congo (Brazzaville) | 01.06.1983 | 27.02.1988 | 4.8 | 42.3 | No |
| Dominican Republic | 01.06.1982 | 24.02.1986 | 3.8 | 49.9 | No | Rep. Of Congo (Brazzaville) | 01.03.1988 | 14.12.2007 | 19.8 | 90.8 | Yes |
| Dominican Republic | 01.06.1987 | 30.08.1994 | 7.3 | 50.5 | No | Romania | 01.09.1981 | 07.12.1982 | 1.3 | 32.9 | Yes |
| Dominican Republic | 01.04.2004 | 11.05.2005 | 1.2 | 4.7 | No | Romania | 01.01.1983 | 20.06.1983 | 0.5 | 31.7 | No |
| Dominican Republic | 01.08.2004 | 18.10.2005 | 1.3 | 11.3 | No | Romania | 01.06.1986 | 01.09.1986 | 0.3 | 12.3 | Yes |
| Ecuador | 08.10.1982 | 14.10.1983 | 1.1 | 6.3 | No | Russia | 01.08.1991 | 01.12.1997 | 6.4 | 26.2 | No |
| Ecuador | 01.12.1983 | 09.08.1984 | 0.8 | 5.7 | No | Russia | 17.08.1998 | 07.05.1999 | 0.8 | 46.0 | No |
| Ecuador | 01.08.1984 | 11.12.1985 | 1.4 | 15.4 | No | Russia | 20.11.1998 | 25.08.2000 | 1.8 | 50.8 | No |
| Ecuador | 01.08.1986 | 28.02.1995 | 8.6 | 42.2 | No | Russia | 20.04.1999 | 03.02.2000 | 0.9 | 51.5 | No |
| Ecuador | 28.01.1999 | 23.08.2000 | 1.7 | 38.3 | No | Senegal | 01.05.1981 | 01.02.1984 | 2.8 | 28.8 | No |
| Ecuador | 14.11.2008 | 03.06.2009 | 0.7 | 67.7 | No | Senegal | 01.06.1985 | 07.05.1985 | 0.1 | 31.3 | No |
| Ethiopia | 01.06.1990 | 16.01.1996 | 5.7 | 92.0 | No | Senegal | 01.06.1990 | 28.09.1990 | 0.3 | 35.7 | No |
| Gabon | 15.09.1986 | 01.12.1987 | 1.3 | 7.9 | No | Senegal | 01.06.1992 | 18.12.1996 | 4.6 | 92.0 | No |
| Gabon | 01.06.1989 | 16.05.1994 | 5.0 | 16.2 | No | Serbia | 01.06.1992 | 22.07.2004 | 12.2 | 70.9 | Yes |
| Gambia | 01.06.1984 | 15.02.1988 | 3.8 | 49.3 | Yes | Seychelles | 01.07.2008 | 11.02.2010 | 1.7 | 56.2 | No |
| Greece | 01.07.2011 | 13.03.2012 | 0.8 | 64.6 | No | Sierra Leone | 01.06.1980 | 01.08.1995 | 15.3 | 88.6 | Yes |
| Grenada | 01.10.2004 | 16.11.2005 | 1.2 | 33.9 | No | Slovenia | 01.06.1992 | 12.03.1996 | 3.8 | 3.3 | No |
| Guinea | 01.06.1985 | 20.04.1988 | 2.9 | 26.1 | No | South Africa | 01.09.1985 | 24.03.1987 | 1.6 | 8.5 | No |
| Guinea | 01.06.1991 | 01.12.1998 | 7.6 | 87.0 | No | South Africa | 01.06.1989 | 18.10.1989 | 0.4 | 12.7 | No |
| Guyana | 01.06.1982 | 24.11.1992 | 10.5 | 89.2 | Yes | South Africa | 01.01.1992 | 27.09.1993 | 1.8 | 22.0 | No |
| Guyana | 01.01.1993 | 01.12.1999 | 7.0 | 91.0 | No | St. Kitts & Nevis | 01.06.2011 | 01.04.2012 | 0.9 | 62.9 | No |
| Honduras | 01.06.1981 | 01.10.1989 | 8.4 | 73.2 | Yes | Sudan | 01.06.1975 | 01.10.1985 | 10.4 | 54.6 | Yes |
| Honduras | 01.06.1990 | 01.08.2001 | 11.3 | 82.0 | Yes | São Tomé and Príncipe | 01.06.1984 | 01.08.1994 | 10.3 | 90.0 | No |
| Iraq | 01.09.1986 | 01.01.2006 | 19.4 | 89.4 | Yes | Tanzania | 01.06.1981 | 01.01.2004 | 22.7 | 88.0 | Yes |
| Jamaica | 01.06.1977 | 01.09.1978 | 1.3 | 2.2 | No | Togo | 01.06.1987 | 01.05.1988 | 1.0 | 46.0 | No |
| Jamaica | 01.05.1978 | 01.04.1979 | 1.0 | 3.5 | No | Togo | 01.06.1991 | 01.12.1997 | 6.6 | 92.3 | No |
| Jamaica | 01.03.1980 | 20.06.1981 | 1.3 | 15.2 | Yes | Trinidad & Tobago | 01.09.1988 | 20.12.1989 | 1.3 | 15.5 | No |
| Jamaica | 01.06.1983 | 01.06.1984 | 1.1 | 18.1 | Yes | Turkey | 02.12.1976 | 22.08.1979 | 2.8 | 19.5 | No |
| Jamaica | 01.07.1984 | 01.09.1985 | 1.3 | 31.7 | No | Turkey | 01.12.1976 | 01.06.1979 | 2.6 | 22.2 | No |
| Jamaica | 01.09.1986 | 07.05.1987 | 0.8 | 32.8 | Yes | Turkey | 01.01.1981 | 01.08.1981 | 0.7 | 8.6 | No |
| Jamaica | 01.01.1990 | 26.06.1990 | 0.5 | 44.0 | No | Turkey | 01.01.1981 | 13.03.1982 | 1.3 | 17.0 | No |
| Jordan | 01.02.1989 | 23.12.1993 | 4.9 | 54.6 | No | Uganda | 01.06.1979 | 26.02.1993 | 13.8 | 88.0 | No |
| Kenya | 01.01.1992 | 02.06.1998 | 6.5 | 45.7 | No | Ukraine | 12.08.1998 | 21.09.1998 | 0.2 | 11.8 | No |
| Liberia | 01.11.1980 | 01.12.1982 | 2.2 | 35.7 | No | Ukraine | 12.08.1998 | 20.10.1998 | 0.3 | 14.7 | No |
| Liberia | 01.11.1980 | 01.04.2009 | 28.5 | 97.0 | Yes | Ukraine | 18.05.1999 | 20.08.1999 | 0.3 | -8.3 | No |
| Macedonia | 01.05.1992 | 26.03.1997 | 4.9 | 34.6 | Yes | Ukraine | 10.01.2000 | 07.04.2000 | 0.3 | 18.0 | No |
| Madagascar | 01.05.1981 | 01.11.1981 | 0.6 | 19.0 | No | Uruguay | 01.01.1983 | 29.07.1983 | 0.6 | 0.7 | No |
| Madagascar | 01.06.1982 | 25.10.1984 | 2.4 | 41.3 | No | Uruguay | 01.04.1985 | 10.07.1986 | 1.3 | 24.3 | No |
| Madagascar | 01.06.1985 | 15.06.1987 | 2.1 | 13.7 | No | Uruguay | 01.05.1987 | 04.03.1988 | 0.9 | 20.3 | No |
| Madagascar | 01.06.1987 | 10.04.1990 | 2.9 | 52.7 | No | Uruguay | 01.07.1989 | 31.01.1991 | 1.6 | 26.3 | No |
| Malawi | 12.07.1982 | 06.03.1983 | 0.8 | 28.5 | No | Uruguay | 11.03.2003 | 29.05.2003 | 0.3 | 9.8 | No |
| Malawi | 01.08.1987 | 04.10.1988 | 1.3 | 39.2 | No | Venezuela | 01.03.1983 | 27.02.1986 | 3.0 | 9.9 | No |
| Mauritania | 01.06.1992 | 01.08.1996 | 4.3 | 90.0 | No | Venezuela | 24.04.1986 | 18.09.1987 | 1.5 | 4.3 | No |
| Mexico | 01.08.1982 | 27.08.1983 | 1.1 | -0.2 | No | Venezuela | 12.01.1989 | 05.12.1990 | 2.0 | 36.7 | No |
| Mexico | 01.05.1984 | 29.03.1985 | 0.9 | 2.2 | No | Vietnam | 01.01.1982 | 05.12.1997 | 16.0 | 52.0 | Yes |
| Mexico | 01.05.1984 | 29.08.1985 | 1.3 | 5.4 | No | Yemen | 01.06.1983 | 01.02.2001 | 17.8 | 97.0 | No |
| Mexico | 02.09.1986 | 01.03.1987 | 0.6 | 18.1 | No | Yugoslavia | 01.01.1983 | 09.09.1983 | 0.8 | 6.5 | No |
| Mexico | 01.08.1987 | 01.03.1988 | 0.7 | 56.3 | No | Yugoslavia | 01.09.1983 | 16.05.1984 | 0.8 | -7.5 | No |
| Mexico | 01.12.1988 | 04.02.1990 | 1.3 | 30.5 | No | Yugoslavia | 01.06.1984 | 18.12.1985 | 1.6 | 14.5 | No |
| Moldova | 01.06.2001 | 17.06.2004 | 3.1 | 56.3 | No | Yugoslavia | 01.07.1987 | 21.09.1988 | 1.3 | 19.7 | No |
| Moldova | 12.06.2002 | 29.10.2002 | 0.4 | 36.9 | No | Zambia | 07.01.1983 | 14.09.1994 | 11.8 | 89.0 | Yes |
| Morocco | 25.08.1983 | 01.02.1986 | 2.6 | 23.5 | No | | | | | | |

– **Default duration**: Default dates come from Asonuma and Trebesch (2016). In Appendix B, I also use the definition of Standard & Poor's in Beers and Chambers (2006) which often aggregates restructurings together.[29]

[29] According to Asonuma and Trebesch (2016), a default starts whenever a borrower misses some payments

– **Private lenders losses**: Haircut statistics on private lenders come from Cruces and Trebesch (2013).[30] I use both the market haircut and the one of Sturzenegger and Zettelmeyer (2008) that I denote by SZ haircut. Haircuts account for private lenders and disregard official lenders.

– **Lenders in default**: Beers et al. (2022) report the lenders involved in each default episode.[31] The dataset specifies 9 types of foreign lenders: the IMF, the IBRD, the IDA, the Paris Club, China, other official lenders, banks, bondholders and other private lenders. I merge the IMF, the IBRD and the IDA together under the label of multilateral lenders. I also group China together with other official lenders. Finally, I add bondholders and other private lenders together.[32]

– **National accounts**: National accounting statistics on nominal GDP, real GDP, real GDP per capita, GDP deflator, real consumption, real exports and real imports come from the UN.

– **Debt and loans**: Statistics on external debt primarily come from the WB's World Development Indicators (WDI) and International Debt Statistics (IDS). The WB provides data on external debt stock and a breakdown by lenders: multilateral, bilateral and private. The IMF debt corresponds to the "use of IMF credit". The WB debt is the sum of IBRD loans and IDA credits. Missing values are filled by the joint BIS-IMF-OECD-WB Statistics and IMF's International Financial Statistics (IFS) data with entry "net credit and loans from the IMF". For Yugoslavia, Uruguay and Panama, missing data are directly retrieved from the IMF annual report and the WB project list.

– **Interest rates and spreads**: EMBI+ data come from the Global Financial Data and the WB's Global Economic Monitor (GEM). Yields on US government bonds come from the US Treasury and the Federal Funds rate from the Federal Reserve Bank of St. Louis. The IMF adjusted rate of charge and the IDA service charge come from

beyond any contract-specified grace period, or if the borrower undergoes renegotiations of the original debt contract. A default ends with the official settlement announcement or the implementation of the debt exchange. In opposition, according to Beers and Chambers (2006), a default ends when a settlement occurs with no prospects of further resolutions.

[30] I use the database updated in 2014. In addition to revised computations, the update contains new default cases. Note that the haircut of Greece follows the estimation of Zettelmeyer et al. (2014). In the updated dataset, two starting dates are missing: Nicaragua ending in 2007 and Mozambique ending in 2007. For these defaults, I take the starting date following the latest reported restructuring. This is consistent with the dates reported in Beers and Chambers (2006).

[31] Missing values are coded as an absence of default. However, cells marked with an asterisk in the original dataset (i.e. missing value on defaulted debt) are coded as a default.

[32] Results do not significantly change if I consider those two categories separately.

the IMF's and the WB's websites, respectively. For the IBRD lending rate, I gather the historical data on the IBRD Statement Of Loans. I take the average rate over the entire set of loans. For loans which do not report interest rates, I take the 5-year Libor rate to which I add the standard front-end fee of 0.25%, the commitment fee of 0.25%, the contractual spread of 0.50% and the excess borrowing charge of 0.50%. Following Boz (2011) and Fink and Scholl (2016), spreads on multilateral rates are calculated as the rate charged minus 1-year US government bonds yield.

– **IMF programs and WB adjustment loans**: Dreher and Gassebner (2012) offer a set of dummy variables accounting for the IMF's Structural Adjustment Facility (SAF), Poverty Reduction and Growth Facility (PRGF) and Stand-by Agreement (SBA) programs active for at least five months as well as the WB's loans given for structural adjustment in effect for at least five months. I extend the dataset until 2014 by means of the IMF Monitoring of Fund Arrangements (MONA) database and the WB Projects & Operations listing. I also construct a dummy for countries being part of the IDA or the HIPC initiative using the IDA's and the IMF's websites.

– **Political regimes and wars**: Bjørnskov and Rode (2020) offer a set of dummy variables to account for the type of and the change in political regimes (e.g. communist, dictatorship and democracy). It also reports legislative elections, postponed legislative elections and coups. In addition, Sarkees and Wayman (2010) construct dummy variables keeping track of inter and intra-state wars.[33]

# B Regression Analysis

This section assesses the robustness of the empirical facts presented in Section 2. While Facts I, II and IV can be directly imputed to the multilateral lenders, Facts III, V and VI might be associated to different factors.[34]

## B.1 Debt regressions

Regarding Fact III, I run fixed effects regressions controlling for the economic and political stand of each country. I estimate the following equation

$$\frac{B^m_{i,t} - B^m_{i,t-1}}{GDP_{i,t}} = a_i + \beta_1 DS_{i,t} + \beta_2 DC_{i,t} + \mathbf{X}_{i,t}\delta + u_{i,t},$$

[33] I do not use the political risk rating from Political Risk Services Group as it only start in 1984 and does not cover all countries in my sample.

[34] The following regression analyses are not necessarily causal.

where $i$ refers to a specific country, $t$ refers to a specific year, $B^m$ is the sum of IMF and WB debt, $DS$ is a dummy variable taking value one if the country enters in default, $DC$ is a dummy variable taking value one if the country stays in default, $\mathbf{X}$ is a vector of controls, $a$ is a country-specific constant and the remaining variable is the error term, $u$. I consider two specifications for the default dates: the definition Asonuma and Trebesch (2016) denoted by A&T and the definition of Standard & Poor's denoted by S&P.

Table B.2: Panel Debt Regressions

| | (1) A&T | (2) A&T | (3) A&T | (4) S&P | (5) S&P | (6) S&P |
|---|---|---|---|---|---|---|
| Default Start | 0.84*** | 0.57*** | 0.57*** | 0.83*** | 0.51*** | 0.49*** |
| | [0.12] | [0.14] | [0.14] | [0.15] | [0.16] | [0.16] |
| Default Continuation | 0.89*** | 0.64*** | 0.65*** | 0.86*** | 0.62*** | 0.63*** |
| | [0.19] | [0.18] | [0.19] | [0.17] | [0.16] | [0.17] |
| Federal Funds Rate | | -0.00 | -0.01 | | -0.00 | -0.01 |
| | | [0.02] | [0.02] | | [0.02] | [0.02] |
| Real GDP Growth | | -0.03 | -0.03 | | -0.03 | -0.03 |
| | | [0.04] | [0.04] | | [0.04] | [0.04] |
| Real GDP per Capita Growth | | -0.00 | -0.00 | | -0.01 | -0.00 |
| | | [0.03] | [0.03] | | [0.03] | [0.03] |
| Inflation | | -0.01** | -0.01*** | | -0.01** | -0.01** |
| | | [0.01] | [0.01] | | [0.01] | [0.01] |
| Trade Openness | | -0.38* | -0.38* | | -0.37* | -0.37* |
| | | [0.20] | [0.20] | | [0.20] | [0.19] |
| Net Exports (% GDP) | | 0.00 | 0.00 | | 0.00 | 0.00 |
| | | [0.00] | [0.00] | | [0.00] | [0.00] |
| IMF Program | | 0.92*** | 0.94*** | | 0.93*** | 0.95*** |
| | | [0.21] | [0.21] | | [0.21] | [0.21] |
| WB Adjustment loans | | -0.01 | -0.01 | | -0.01 | -0.01 |
| | | [0.02] | [0.02] | | [0.02] | [0.02] |
| Coup | | | 0.51** | | | 0.50** |
| | | | [0.22] | | | [0.22] |
| Legislative Election | | | 0.08 | | | 0.06 |
| | | | [0.13] | | | [0.13] |
| Postponed Legislative Election | | | -0.97 | | | -0.94 |
| | | | [1.58] | | | [1.58] |
| War | | | -0.26 | | | -0.13 |
| | | | [0.20] | | | [0.16] |
| Civil War | | | -0.36 | | | -0.38 |
| | | | [0.23] | | | [0.23] |
| Constant | 0.31*** | 0.73*** | 0.80*** | 0.32*** | 0.72*** | 0.80*** |
| | [0.04] | [0.13] | [0.14] | [0.04] | [0.12] | [0.14] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 2971 | 2971 | 2971 | 2965 | 2965 | 2965 |
| Countries | 72 | 72 | 72 | 72 | 72 | 72 |
| $R^2$ adjusted | 0.01 | 0.03 | 0.03 | 0.01 | 0.03 | 0.03 |

*Note*: *** $p < .01$, ** $p < .05$, * $p < .10$. Robust standard errors in brackets.

For the choice of control variables I follow the literature on the determinants of default.[35] I consider two sets of controls. The first one accounts for the economic condition of each country: the IMF-debt-to-GDP ratio, the WB-debt-to-GDP ratio, the real GDP growth, the real GDP per capita growth, the net export per GDP, the inflation rate, the US Federal Funds Rate and the trade openness measured by the sum of exports and imports over GDP. Reinhart and Trebesch (2016) show that defaults often overlap with an IMF program. I therefore include a dummy taking value one if an IMF program (SAF, PRGF or SBA) is in effect for at least five months. Besides this, I introduce a variable counting the number of WB adjustment loans in effect for at least five months.

The second set of control variables accounts for the political situation of each country. I control for inter and intra-state wars using two separate dummies. For the political system, I add a set of dummy variables accounting for whether there has been legislative elections or those elections have been postponed and whether there has been a coup.

The outcome of the fixed effects regressions is depicted in Table B.2. There is a strong and positive association between the change in IMF and WB debt and defaults. A default start is associated with an increase in IMF and WB debt between 0.5 and 0.8 percentage points of GDP depending on the model's specification. The effect is even stronger ranging between 0.6 and 0.9 when looking at the default continuation. Hence, Fact III is relatively robust. Controlling for the specificity of each country does not reduce the strong association between multilateral debt and the occurrence of defaults.

### B.2 Duration regressions

Regarding Fact V, I run two types of regressions. First, I conduct a cross-sectional analysis controlling for the default's and the country's specificities using an OLS estimator. Second, I run a longitudinal analysis with similar control variables using a semi-parametric Cox proportional hazard model. For the OLS regression, I estimate the following equation

$$L_i^k = \alpha + \mathbf{D}_i \beta + \mathbf{X}_i \delta + v_i,$$

where $i$ refers to a specific default episode, $L^k$ is the default duration in years with $k \in \{\text{A\&P}, \text{S\&P}\}$ defined previously, $\mathbf{D}$ is a vector of 5 dummy variables accounting for the type lenders involved in the default (i.e. multilateral lenders, Paris Club, other official lenders, banks and bonds and other private lenders), $\mathbf{X}$ is a vector of controls, $\alpha$ is a constant and the remaining variable is the error term, $v$.

[35] See for instance Dell'Ariccia et al. (2006), Trebesch (2008), Cruces and Trebesch (2013), Asonuma and Trebesch (2016) and Asonuma and Joo (2020).

As for the previous regressions, I account for two sets of control variables. The first one accounts for the economic condition. In addition to the variables considered in the previous subsection, I add a dummy for serial defaulters taking value one if the country defaulted more than twice in the period under study following Reinhart and Rogoff (2004). I also introduce a dummy to account for whether the country is eligible for the HIPC or IDA programs. Moreover, I include the total amount of private debt defaulted and a dummy variable taking value one in case of a Brady deal.

The second set of control variables accounts for the political environment. In addition to the variables considered in the previous subsection, I add a set of dummy variables accounting for whether the defaulting country is a communist regime and whether it is a dictatorial regime the year of the default or the year preceding it. Finally, following Cruces and Trebesch (2013), I introduce year and region fixed effects. The latter accounts for the fact that defaults have very different characteristics (including unobservables) depending on its geographical location. The year fixed effects control for potential issues in the timing since defaults often happen in waves as shown by Reinhart and Rogoff (2009).

The outcome of the OLS duration regressions is depicted in Table B.3. There is a strong and positive association between defaults with multilateral lenders and the length of the default. A default on multilateral debt is associated with a default's duration between 5 and 7 additional years depending on the model's specification. In opposition, the association between the Paris Club and the default's length is ambiguous as it reverses across the different specifications. The same holds true for the other official lenders. Regarding private lenders, it seems that defaults on bank loans are settled more quickly.

I now turn to the Cox proportional hazard model. The major advantage of this model compared to an OLS regression is that it can integrate both constant and time-varying covariates. I estimate the following equation

$$g_i^k(t) = g_0^k(t)\exp(\mathbf{D}_i\beta + \mathbf{X}_i\delta),$$

where $i$ refers to a specific default episode and $t$ indicates the survival time (i.e. the time in default), $g^k(t)$ is the hazard function and $g_0^k$ is the baseline hazard for $k \in \{\text{A\&P}, \text{S\&P}\}$. Using the duration jargon, a failure corresponds to the moment in which the country exits the default state. The period of observation spans from the moment the country enters the default to the moments it exits. As I solely consider settled default episodes, there is no censoring. Note that the Cox model cannot account for defaults starting and ending in the same year as the failure coincides with the observation's start. I therefore lose 6 episodes for the S&P definition and 27 episodes for the A&T definition.

Table B.3: OLS Duration Regressions

| | (1) A&T | (2) A&T | (3) A&T | (4) S&P | (5) S&P | (6) S&P |
|---|---|---|---|---|---|---|
| Multilateral Lenders | 5.21*** | 4.75*** | 4.86*** | 6.06*** | 6.77*** | 7.47*** |
| | [1.30] | [1.35] | [1.31] | [1.79] | [2.10] | [2.41] |
| Paris Club | 1.00 | 0.93 | 0.70 | 0.33 | -0.95 | -1.22 |
| | [0.66] | [0.72] | [0.76] | [1.74] | [1.82] | [1.83] |
| Other Official Lenders | 1.02 | -0.53 | -0.42 | 4.47 | 0.86 | -0.86 |
| | [1.09] | [1.13] | [1.07] | [3.90] | [4.08] | [3.99] |
| Bank Loans | -1.42* | -2.78** | -2.84* | -1.46 | -3.85 | -4.59* |
| | [0.84] | [1.23] | [1.52] | [1.85] | [2.40] | [2.57] |
| Bonds and Other Private Lenders | 0.35 | 0.59 | 0.59 | -0.73 | 1.85 | 3.88 |
| | [1.15] | [1.11] | [1.03] | [4.31] | [4.18] | [3.80] |
| Private Debt Restructured | | 0.00*** | 0.00*** | | 0.00 | 0.00 |
| | | [0.00] | [0.00] | | [0.00] | [0.00] |
| Brady Deal | | 3.99*** | 3.79*** | | 5.42** | 5.56** |
| | | [1.18] | [1.25] | | [2.17] | [2.41] |
| HIPC or IDA Eligibility | | 2.14* | 2.26* | | 5.36** | 5.32* |
| | | [1.22] | [1.35] | | [2.63] | [2.69] |
| Serial Defaulter | | 1.89* | 1.53 | | -1.30 | -1.71 |
| | | [1.12] | [1.21] | | [1.83] | [1.96] |
| Federal Fund Rate, Start | | 0.74 | 0.50 | | 0.62 | 0.14 |
| | | [0.64] | [0.75] | | [0.94] | [1.03] |
| Real GDP Growth, Start | | 0.14 | 0.37 | | 0.20 | 0.48 |
| | | [0.52] | [0.53] | | [0.71] | [0.81] |
| Real GDP per Capita Growth, Start | | -0.13 | -0.35 | | -0.31 | -0.53 |
| | | [0.53] | [0.55] | | [0.74] | [0.84] |
| Inflation, Start | | 0.00 | 0.00 | | 0.03 | 0.03 |
| | | [0.02] | [0.02] | | [0.04] | [0.05] |
| Trade Openness, Start | | 0.01 | 0.01 | | 0.00 | 0.01 |
| | | [0.01] | [0.01] | | [0.02] | [0.02] |
| Net Exports (% GDP), Start | | -0.00 | -0.00 | | 0.02 | 0.01 |
| | | [0.03] | [0.03] | | [0.05] | [0.05] |
| IMF Program, Start | | -0.87 | -1.91 | | -0.89 | -0.55 |
| | | [1.29] | [1.34] | | [1.61] | [1.63] |
| WB Adjustment loans, Start | | -0.09 | -0.07 | | -0.25 | -0.40 |
| | | [0.18] | [0.20] | | [0.42] | [0.46] |
| IMF Debt (% GDP), Start | | -0.09 | -0.07 | | -0.05 | -0.16 |
| | | [0.08] | [0.08] | | [0.12] | [0.14] |
| WB Debt (% GDP), Start | | -0.01 | -0.01 | | -0.23 | -0.23 |
| | | [0.08] | [0.09] | | [0.17] | [0.18] |
| Communist Regime, Start | | | 0.67 | | | -0.65 |
| | | | [1.10] | | | [2.02] |
| Dictatorial Regime, Start | | | 0.36 | | | 1.96 |
| | | | [0.79] | | | [1.69] |
| Coup, Start | | | 0.76 | | | 1.61 |
| | | | [1.26] | | | [2.65] |
| Legislative Election, Start | | | -0.26 | | | -0.31 |
| | | | [0.75] | | | [1.52] |
| Postponed Legislative Election, Start | | | -1.65 | | | 6.30 |
| | | | [2.23] | | | [4.45] |
| War, Start | | | 2.50 | | | 3.71 |
| | | | [1.95] | | | [3.23] |
| Civil War, Start | | | -2.77* | | | 2.05 |
| | | | [1.59] | | | [4.29] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Region FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 187 | 187 | 187 | 104 | 104 | 104 |
| $R^2$ adjusted | 0.32 | 0.39 | 0.38 | 0.35 | 0.43 | 0.40 |

*Note*: *** $p < .01$, ** $p < .05$, * $p < .10$. Robust standard errors in brackets.

Table B.4: Cox Duration Regressions

| | (1) A&T | (2) A&T | (3) A&T | (4) S&P | (5) S&P | (6) S&P |
|---|---|---|---|---|---|---|
| Multilateral Lenders | 0.36*** | 0.46*** | 0.46*** | 0.28*** | 0.31*** | 0.30*** |
| | [0.07] | [0.09] | [0.09] | [0.07] | [0.09] | [0.09] |
| Paris Club | 0.84 | 0.77 | 0.76 | 0.68 | 0.75 | 0.83 |
| | [0.14] | [0.15] | [0.15] | [0.18] | [0.21] | [0.25] |
| Other Official Lenders | 0.90 | 1.18 | 1.17 | 0.82 | 1.58 | 1.33 |
| | [0.23] | [0.34] | [0.34] | [0.40] | [0.79] | [0.76] |
| Bank Loans | 1.24 | 1.18 | 1.21 | 1.07 | 0.89 | 0.87 |
| | [0.39] | [0.43] | [0.43] | [0.37] | [0.36] | [0.35] |
| Bonds and Other Private Lenders | 0.74 | 0.88 | 0.90 | 0.48 | 0.32** | 0.34** |
| | [0.20] | [0.26] | [0.28] | [0.26] | [0.14] | [0.17] |
| Private Debt Restructured | | 1.00*** | 1.00*** | | 1.00*** | 1.00** |
| | | [0.00] | [0.00] | | [0.00] | [0.00] |
| Brady Deal | | 0.55** | 0.53** | | 0.49*** | 0.48** |
| | | [0.14] | [0.15] | | [0.13] | [0.14] |
| HIPC or IDA Eligibility | | 0.52** | 0.48** | | 0.23*** | 0.26*** |
| | | [0.17] | [0.16] | | [0.10] | [0.13] |
| Serial Defaulter | | 0.82 | 0.78 | | 1.12 | 1.17 |
| | | [0.19] | [0.19] | | [0.30] | [0.33] |
| Federal Funds Rate | | 0.02*** | 0.02*** | | 0.01*** | 0.01*** |
| | | [0.00] | [0.00] | | [0.00] | [0.00] |
| Real GDP Growth | | 1.01 | 1.01 | | 1.02 | 1.02 |
| | | [0.03] | [0.03] | | [0.04] | [0.04] |
| Real GDP per Capita Growth | | 0.99 | 0.98 | | 0.96 | 0.96 |
| | | [0.03] | [0.03] | | [0.04] | [0.04] |
| Inflation | | 1.00 | 1.00 | | 1.01 | 1.01 |
| | | [0.00] | [0.00] | | [0.01] | [0.01] |
| Trade Openness | | 0.61* | 0.61* | | 0.83 | 0.84 |
| | | [0.17] | [0.17] | | [0.32] | [0.32] |
| Net Exports (% GDP) | | 1.00 | 1.00 | | 0.99 | 0.99 |
| | | [0.01] | [0.01] | | [0.01] | [0.01] |
| IMF Program | | 1.43*** | 1.46** | | 2.11*** | 2.13*** |
| | | [0.20] | [0.22] | | [0.47] | [0.54] |
| WB Adjustment loans | | 1.11** | 1.12** | | 1.12* | 1.12* |
| | | [0.05] | [0.05] | | [0.07] | [0.07] |
| IMF Debt (% GDP), Start | | 1.04** | 1.05*** | | 1.02 | 1.02 |
| | | [0.02] | [0.02] | | [0.02] | [0.02] |
| WB Debt (% GDP), Start | | 0.98 | 0.98 | | 0.97 | 0.97 |
| | | [0.02] | [0.02] | | [0.03] | [0.03] |
| IMF Debt (% GDP), End | | 0.99 | 0.99 | | 1.01 | 1.01 |
| | | [0.01] | [0.01] | | [0.01] | [0.01] |
| WB Debt (% GDP), End | | 0.96*** | 0.96*** | | 1.00 | 1.00 |
| | | [0.01] | [0.01] | | [0.02] | [0.02] |
| Communist Regime | | | 1.24 | | | 0.94 |
| | | | [0.33] | | | [0.45] |
| Dictatorial Regime | | | 0.92 | | | 0.98 |
| | | | [0.18] | | | [0.33] |
| Coup | | | 1.28 | | | 1.41 |
| | | | [0.45] | | | [0.79] |
| Legislative Election | | | 0.89 | | | 1.18 |
| | | | [0.12] | | | [0.25] |
| Postponed Legislative Election | | | 0.94 | | | 1.03 |
| | | | [0.57] | | | [0.77] |
| War | | | 1.04 | | | 1.51 |
| | | | [0.79] | | | [1.23] |
| Civil War | | | 1.08 | | | 0.76 |
| | | | [0.26] | | | [0.23] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Region FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 655 | 655 | 655 | 671 | 671 | 671 |
| Episodes | 160 | 160 | 160 | 98 | 98 | 98 |
| Pseudo $R^2$ | 0.06 | 0.08 | 0.08 | 0.14 | 0.18 | 0.18 |

*Note*: *** $p < .01$, ** $p < .05$, * $p < .10$. Robust standard errors in brackets. Hazard ratios are reported.

In terms of controls, I use the same variables as before. The major difference with the OLS regression is that most control variables are time-varying. The only exceptions are the IMF-debt-to-GDP ratio and the WB-debt-to-GDP ratio as the time series are incomplete for many countries. I therefore integrate those two variable as constant over time and add their value both at the beginning and at the end of the default episode.

The outcome of the Cox duration regressions is depicted in Table B.4. I find similar results as in the OLS estimation. Nevertheless, the interpretation of the coefficient is here different as I report the hazard ratios. An hazard ratio above one means that the variable is associated with a greater probability of exiting default, while a ratio below one indicates the opposite. As before, a default implicating multilateral lenders is related to a longer default. More precisely, such event is associated with a reduced probability of exiting default between 54% and 72% depending on the model's specification. Moreover, defaults involving the Paris Club seem to reduce the probability of exiting default, while the opposite holds for the other official lenders. Nevertheless, the coefficients lack robustness. Regarding private lenders, defaults on bank loans are settled more quickly than defaults on bonds. Again, the magnitude and the statistical significance of the coefficients vary a great deal across the different specifications.

In view of the results presented above, Fact V is relatively robust. Controlling for the specificity of each default episodes and the country's characteristics does not reduce the strong association between the default's duration and multilateral lenders.

### B.3 Haircut regressions

Regarding Fact VI, I run OLS regressions with similar controls as for the duration regression. I estimate is the following equation

$$H_i^k = \mathbf{D}_i\beta + \mathbf{X}_i\delta + u_i,$$

where $i$ refers to a specific default episode, $H_i^k$ is the haircut with specification $k \in \{M, SZ\}$ defined previously and $u_i$ is the error term. I consider two specifications of the haircut: the market haircut, $H^M$, and the haircut based on Sturzenegger and Zettelmeyer (2008), $H^{SZ}$.

I control for the economic and political conditions of the countries in default using the same control variables as for the OLS duration regressions. I also introduce year and region fixed effects.

Table B.5: Haircut Regressions

| | (1) $H^{SZ}$ | (2) $H^{SZ}$ | (3) $H^{SZ}$ | (4) $H^{M}$ | (5) $H^{M}$ | (6) $H^{M}$ |
|---|---|---|---|---|---|---|
| Multilateral Lenders | 13.42** | 10.38** | 10.80** | 13.18** | 10.11** | 10.33** |
| | [5.48] | [4.54] | [4.69] | [5.38] | [4.67] | [4.87] |
| Paris Club | 12.11*** | 11.40*** | 10.61*** | 12.37*** | 10.91*** | 10.33*** |
| | [4.56] | [3.27] | [3.26] | [4.44] | [3.12] | [3.14] |
| Other Official Lenders | 13.73* | 9.68 | 10.13 | 15.01** | 10.62 | 10.91 |
| | [7.26] | [7.73] | [7.86] | [7.40] | [7.79] | [7.97] |
| Bank Loans | 24.26*** | 22.83*** | 23.48*** | 21.07*** | 19.11*** | 19.44*** |
| | [7.93] | [7.18] | [7.30] | [7.88] | [6.95] | [7.00] |
| Bonds and Other Private Lenders | -14.30** | -13.03* | -10.39 | -15.15** | -13.59* | -11.68 |
| | [7.11] | [7.17] | [7.33] | [7.23] | [7.29] | [7.49] |
| Private Debt Restructured | | 0.00* | 0.00* | | 0.00** | 0.00** |
| | | [0.00] | [0.00] | | [0.00] | [0.00] |
| Brady Deal | | 1.76 | 0.16 | | 8.00 | 6.97 |
| | | [6.47] | [6.94] | | [5.42] | [5.83] |
| HIPC or IDA Eligibility | | 13.27** | 10.39* | | 14.86*** | 12.69** |
| | | [5.68] | [6.05] | | [5.40] | [5.79] |
| Serial Defaulter | | 5.52 | 4.28 | | 4.23 | 3.29 |
| | | [5.64] | [5.84] | | [5.18] | [5.40] |
| Federal Funds Rate, End | | -10.31*** | -9.62*** | | -9.43*** | -9.01*** |
| | | [1.88] | [2.04] | | [1.79] | [1.98] |
| Real GDP Growth, End | | -3.95* | -3.91* | | -3.90* | -3.90* |
| | | [2.13] | [2.15] | | [2.10] | [2.14] |
| Real GDP per Capita Growth, End | | 4.43** | 4.43** | | 4.40** | 4.41** |
| | | [2.14] | [2.14] | | [2.12] | [2.14] |
| Inflation, End | | 0.10 | 0.13 | | 0.11 | 0.12 |
| | | [0.09] | [0.10] | | [0.09] | [0.09] |
| Trade Openness, End | | -0.09* | -0.09* | | -0.13*** | -0.12** |
| | | [0.05] | [0.05] | | [0.05] | [0.05] |
| Net Exports (% GDP), End | | -0.13 | -0.15 | | -0.11 | -0.13 |
| | | [0.10] | [0.10] | | [0.09] | [0.10] |
| IMF Program, End | | -0.80 | -0.20 | | -0.88 | -0.40 |
| | | [3.07] | [3.14] | | [2.83] | [2.88] |
| WB Adjustment loans, End | | -0.52 | -0.54 | | -1.04 | -1.05 |
| | | [0.97] | [0.94] | | [0.88] | [0.88] |
| IMF Debt (% GDP), End | | -0.33** | -0.29* | | -0.23 | -0.19 |
| | | [0.14] | [0.16] | | [0.14] | [0.16] |
| WB Debt (% GDP), End | | 1.58*** | 1.55*** | | 1.54*** | 1.52*** |
| | | [0.24] | [0.24] | | [0.23] | [0.23] |
| Communist Regime, End | | | 3.37 | | | 2.42 |
| | | | [5.27] | | | [4.62] |
| Dictatorial Regime, End | | | 3.02 | | | 2.52 |
| | | | [4.21] | | | [4.18] |
| Legislative Election, End | | | -3.55 | | | -2.18 |
| | | | [3.31] | | | [3.24] |
| Postponed Legislative Election, End | | | 0.20 | | | -1.73 |
| | | | [10.50] | | | [9.31] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Region FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 187 | 187 | 187 | 187 | 187 | 187 |
| $R^2$ adjusted | 0.45 | 0.67 | 0.66 | 0.47 | 0.69 | 0.69 |

*Note*: *** $p < .01$, ** $p < .05$, * $p < .10$. Robust standard errors in brackets.

Table B.5 presents the results of the haircut regressions. The coefficient related to multilateral lenders is economically important. Defaulting on such lenders is associated with an increase of the private lenders haircut between 10 and 13 percentage points depending on the model's specification. However, the statistical significance is on average lower than in the previous regression analyses. Defaults involving the Paris Club and the other official lenders are also associated with larger haircuts. The statistical significance is larger for the Paris Club but the economic significance is about the same. Regarding private lenders, defaults on bonds and other private lenders are associated with lower haircuts, while the opposite holds true for bank loans.

Hence, in view of those results, it seems that there is a link between private lender's losses and the presence of multilateral lenders. Even though the statistical significance is slightly less pronounced than for Fact V, the economic significance of this link is important and remains relatively stable across the different specifications.

# C Proofs

## C.1 Proof of Proposition 1

Before proving Proposition 1, I need to show the monotonicity of the borrower's values under repayment and under default. This is the purpose of Proposition C.1.

**Proposition C.1.** *$V^P(z, b_m, b_p)$ is strictly increasing in $b_m + b_p$ and $V^{DF}(z, b_m)$ in $b_m$. $V(z, b_m, b_p)$ is increasing in $(b_m, b_p)$ but not necessarily in $b_m + b_p$.*

*Proof.* Fix $z$ and suppose $b_m^0 + b_p^0 < b_m^1 + b_p^1 < 0$. In $(z, b_m^0, b_p^0)$, the borrower optimally borrows $(b_p^{0\prime}, b_p^{0\prime})$, whereas in $(z, b_m^1, b_p^1)$ the borrower optimally borrows $(b_p^{1\prime}, b_p^{1\prime})$. We then have that

$$
\begin{aligned}
V^P(z, b_m^1, b_p^1) &= u(y(z) + b_m^1 + b_p^1 - q_p(b_p^{1\prime}, b_p^{1\prime})b_p^{1\prime} - q_m(b_p^{1\prime}, b_p^{1\prime})b_m^{1\prime}) + \beta \mathbb{E}_{z'|z} V(z', b_p^{1\prime}, b_m^{1\prime}) \\
&\geq u(y(z) + b_m^1 + b_p^1 - q_p(b_p^{0\prime}, b_p^{0\prime})b_p^{0\prime} - q_m(b_p^{0\prime}, b_p^{0\prime})b_m^{0\prime}) + \beta \mathbb{E}_{z'|z} V(z', b_p^{0\prime}, b_m^{0\prime}) \\
&> u(y(z) + b_m^0 + b_p^0 - q_p(b_p^{0\prime}, b_p^{0\prime})b_p^{0\prime} - q_m(b_p^{0\prime}, b_p^{0\prime})b_m^{0\prime}) + \beta \mathbb{E}_{z'|z} V(z', b_p^{0\prime}, b_m^{0\prime}) \\
&= V^P(z, b_m^0, b_p^0),
\end{aligned}
$$

where the first inequality comes from optimality and the second from $b_m^0 + b_p^0 < b_m^1 + b_p^1$. Now additionally assume that $b_m^0 < b_m^1$. Recall that the value under *partial* default reads

$$
V^{DP}(z, b_m^1) = u(y(z) + b_m^1) + \beta \mathbb{E}_{z'|z} \left[ \max \left\{ V^{DP}(z', 0), V^{EP}(z') \right\} \right].
$$

We then have that $V^{DP}(z, b_m^1) - V^{DP}(z, b_m^0) = u(y(z) + b_m^1) - u(y(z) + b_m^0) > 0$ given the strict monotonicity of $u$ and $b_m^0 < b_m^1$.

Finally, recall that $V(z, b_m, b_p) = \max \left\{ V^P(z, b_m, b_p), V^{DP}(z, b_m), V^{DF}(z) \right\}$. The monotonicity in $b_m$ directly follows from the monotonicity of $V^P(z, b_m, b_p)$ and $V^{DP}(z, b_m)$. The monotonicity is not strict as $V^{DF}(z)$ is independent of $b_m$. Similarly, the monotonicity in $b_p$ directly follows from the monotonicity of $V^P(z, b_m, b_p)$. The monotonicity is again not strict as neither $V^{DP}(z, b_m)$ nor $V^{DF}(z)$ depend on $b_p$. Hence, $V(z, b_m, b_p)$ is monotonic in $(b_m, b_p)$.

However, $V(z, b_m, b_p)$ is not necessarily monotonic in $b_m + b_p$. To see this, suppose as before that $b_m^0 + b_p^0 < b_m^1 + b_p^1 < 0$ but with $b_m^0 > b_m^1$. If $V(z, b_m^1, b_p^1) = V^{DP}(z, b_m^1)$, one then has that $V(z, b_m^0, b_p^0) = V^{DP}(z, b_m^0) > V^{DP}(z, b_m^1) = V(z, b_m^1, b_p^1)$ as $V(z, b_m^1, b_p^1) > V^P(z, b_m^1, b_p^1) > V^P(z, b_m^0, b_p^0)$. □

Having shown the monotonicity of the borrower's value, I can show the existence of two debt thresholds $b_m^{**} \leq b_m^* < \varkappa$.

**Proposition 1.** *There are two threshold values $b_m^{**} \leq b_m^* < \varkappa$ such that if $b_m < b_m^{**}$ there is no risk of partial default and if $b_m \geq b_m^*$ there is no risk of full default.*

*Proof.* Define the set of $z$ for which a *full* default is optimal over a *partial* default

$$DF(b_m) = \left\{z : u(y(z) + b_m) + \beta \mathbb{E}_{z'|z} V^{RP}(z') < u(y(z) + \varkappa) + \beta \mathbb{E}_{z'|z} V^{RF}(z')\right\},$$

where $V^{RP}(z') = \max\{V^{DP}(z', 0), V^P(z', 0, 0)\}$ and $V^{RF}(z') = \max\{v^{DF}(z'), V^P(z', \eta, 0)\}$. Observe that $V^{DP}(z', 0) \leq V^P(z', 0, 0)$ as the borrower can decide not to issue new debt and be equally better off than in autarky. This combined with $V^P(z', 0, 0) > V^P(z', \eta, 0)$ from Proposition C.1 leads to $V^{RP}(z') > V^{RF}(z')$. Moreover, for $b_m \geq \varkappa$, $u(y(z) + b_m) - u(y(z) + \varkappa) \geq 0$ with strict inequality when $b_m > \varkappa$ given the strict monotonicity of $u$. As a result, when $b_m \geq \varkappa$, then $V^{DP}(z, b_m) > V^{DF}(z)$. Thus, there exists a $b_m^* = \inf\{b_m : DF(b_m) = \emptyset\}$ with $b_m^* < \varkappa$. Using the same argument there exists a $b_m^{**} = \sup\{b_m : DF(b_m) = Z\}$. It holds that $b_m^{**} \leq b_m^*$ as $V^{DP}(z, b_m)$ strictly increases in $b_m$ as shown in Proposition C.1 whereas $V^{DF}(z)$ is independent of $b_m$.

Hence, $V^{DF}(z) \leq V^{DP}(z, b_m)$ for all $z$ and all $b_m \geq b_m^*$ meaning that there is no risk of *partial* default. For $b_m < b_m^{**}$ and all $z$, $V^{DF}(z) > V^{DP}(z, b_m)$ meaning that there is no risk of *partial* default. □

### C.2 Proof of Proposition 2

To prove Proposition 2, I rely on Proposition 1 as well as equations (5)-(6).

**Proposition 2.** *$q_m(z, b'_m, b'_p) \geq q_p(z, b'_m, b'_p)$ for all $(z, b'_m, b'_p)$ with strict inequality when there is a risk of partial or full default with market re-entry.*

*Proof.* Consider three cases. First, fix $(z, b'_m, b'_p)$ such that there is no default risk next period. Then $q_m(z, b'_m, b'_p) = q_p(z, b'_m, b'_p) = \frac{1}{1+r}$ from equations (5)-(6).

Second, fix $b_m' \geq b_m^*$ and $b_p'$ such that there is a risk of *partial* default. We have that $q_m(z, b_m', b_p') = \frac{1}{1+r}$ as there is no *full* default following Proposition 1. However, $q_p(z, b_m', b_p') < \frac{1}{1+r}$ as the recovery value of private debt is zero. Hence, $q_p(z, b_m', b_p') < q_m(z, b_m', b_p')$.

Third, fix $b_m' < b_m^*$ and $b_p'$ such that there is a risk of *full* default next period. As $\eta < 0$, $q_m(z, b_m', b_p') = 0$ only occurs if market re-entry is never optimal after a *full* default, i.e. $q_m^{DF}(z, b_m') = 0$. Given that the recovery value of private debt is zero, $q_m(z, b_m', b_p') > q_p(z, b_m', b_p')$ only if market re-entry is optimal upon *full* default. Otherwise, it holds that $q_m(z, b_m', b_p') = q_p(z, b_m', b_p')$. $\square$

### C.3 Proof of Proposition 3

To prove Proposition 3, I first need to show the monotonicity of the two default policies. This is the purpose of Proposition C.2.

**Proposition C.2.** *$D^{DF}(z, b_m, b_p)$ is decreasing in $(b_m, b_p)$ and $D^{DP}(z, b_m, b_p)$ is decreasing in $b_p$ but increasing in $b_m$.*

*Proof.* From Proposition C.1, $V^P(z, b_m, b_p)$ is strictly increasing in $b_m + b_p$ meaning that it is strictly increasing in $(b_m, b_p)$. As $V^{DF}(z)$ does not depend on $(b_m, b_p)$, the monotonicity of $D^{DF}(z, b_m, b_p)$ in $(b_m, b_p)$ follows from the monotonicity of the repayment value. Similarly, as $V^{DP}(z, b_m)$ does not depend on $b_p$, the monotonicity of $D^{DP}(z, b_m, b_p)$ in $b_p$ follows from the monotonicity of the repayment value.

Regarding the monotonicity of $D^{DP}(z, b_m, b_p)$ in $b_m$, Proposition 1 shows that there is no *partial* default when $b_m < b_m^{**}$. As a result, $D^{DP}(z, b_m, b_p) = 0$ for all $b_m < b_m^{**}$. Consider $b_m^{**} \leq \tilde{b}_m < b_m \leq 0$. Denote the optimal borrowing under $b_m$ as $(b_m', b_p')$ and under $\tilde{b}_m$ as $(\tilde{b}_m', \tilde{b}_p')$. The consumption differential between repayment and *partial* default is given by

$$\Delta^{DP}(z, b_m, b_p) \equiv c^P(z, b_m, b_p) - c^{DP}(z, b_m) = b_p - q_p(b_m', b_p')b_p' - q_m(b_m', b_p')b_m',$$

where $c^{DP}(z, b_m) = y(z) + b_m$ is the consumption in *partial* default and $c^P(z, b_m, b_p) = y(z) + b_m + b_p - q_p(b_m', b_p')b_p' - q_m(b_m', b_p')b_m'$ is the consumption in repayment. Assume by contradiction that $\Delta^{DP}(z, \tilde{b}_m, b_p) - \Delta^{DP}(z, b_m, b_p) < 0$. This means that

$$q_p(\tilde{b}_m', \tilde{b}_p')\tilde{b}_p' + q_m(\tilde{b}_m', \tilde{b}_p')\tilde{b}_m' > q_p(b_m', b_p')b_p' + q_m(b_m', b_p')b_m'. \tag{C.1}$$

Denote by $\hat{c}^P(z, \tilde{b}_m, b_p)$ the consumption of the borrower in $(z, \tilde{b}_m, b_p)$ when it borrows $(b_m', b_p')$ instead of $(\tilde{b}_m', \tilde{b}_p')$. Similarly, $\hat{c}^P(z, b_m, b_p)$ is the consumption of the borrower in $(z, b_m, b_p)$ when it borrows $(\tilde{b}_m', \tilde{b}_p')$ instead of $(b_m', b_p')$. From (C.1), $\hat{c}^P(z, \tilde{b}_m, b_p) > c^P(z, \tilde{b}_m, b_p)$ and by optimality

$$u(c^P(z,b_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p) \geq u(\hat{c}^P(z,b_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', \tilde{b}'_m, \tilde{b}'_p). \tag{C.2}$$

Denoting $\delta = \tilde{b}_m - b_m < 0$, observe that $\hat{c}^P(z,\tilde{b}_m,b_p) = c^P(z,b_m,b_p) + \delta$ and $c^P(z,\tilde{b}_m,b_p) = \hat{c}^P(z,b_m,b_p) + \delta$ which gives

$$u(\hat{c}^P(z,\tilde{b}_m,b_p)) - u(c^P(z,\tilde{b}_m,b_p)) > u(c^P(z,b_m,b_p)) - u(\hat{c}^P(z,b_m,b_p)),$$

due to the strict concavity of $u$. This together with (C.2) leads to

$$u(\hat{c}^P(z,\tilde{b}_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p) > u(c^P(z,\tilde{b}_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', \tilde{b}'_m, \tilde{b}'_p),$$

which contradicts the fact that $(\tilde{b}'_m, \tilde{b}'_p)$ is optimal in $(z, \tilde{b}_m, b_p)$. Hence, $\Delta^{DP}(z,\tilde{b}_m,b_p) - \Delta^{DP}(z,b_m,b_p) \geq 0$ meaning that the consumption differential between repayment and *partial* default is decreasing in $b_m$.

Given this I consider two cases. First, suppose that $c^P(z,b_m,b_p) \geq c^{DP}(z,b_m,b_p)$. Following Arellano (2008, Proposition 3), by optimality one obtains

$$u(c^P(z,\tilde{b}_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', \tilde{b}'_m, \tilde{b}'_p) \geq u(\hat{c}^P(z,\tilde{b}_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p).$$

Denote $V^{RP}(z') = \max\{V^{DP}(z',0), V^P(z',0,0)\}$. If

$$\begin{aligned} &u(c^P(z,b_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p) - \left[u(\hat{c}^P(z,\tilde{b}_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p)\right] \leq \\ &u(c^{DP}(z,b_m)) + \beta \mathbb{E}_{z'|z} V^{RP}(z') - \left[u(c^{DP}(z,\tilde{b}_m)) + \beta \mathbb{E}_{z'|z} V^{RP}(z')\right], \end{aligned} \tag{C.3}$$

then one gets the desired result that

$$\begin{aligned} &u(c^P(z,b_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', b'_m, b'_p) - \left[u(c^P(z,\tilde{b}_m,b_p)) + \beta \mathbb{E}_{z'|z} V(z', \tilde{b}'_m, \tilde{b}'_p)\right] \leq \\ &u(c^{DP}(z,b_m)) + \beta \mathbb{E}_{z'|z} V^{RP}(z') - \left[u(c^{DP}(z,\tilde{b}_m)) + \beta \mathbb{E}_{z'|z} V^{RP}(z')\right]. \end{aligned}$$

Simplifying (C.3),

$$u(c^P(z,b_m,b_p)) - u(\hat{c}^P(z,\tilde{b}_m,b_p)) \leq u(c^{DP}(z,b_m)) - u(c^{DP}(z,\tilde{b}_m)). \tag{C.4}$$

Observe that $c^P(z,b_m,b_p) = c^{DP}(z,b_m) + \Delta^{DP}(z,b_m,b_p)$ and $\hat{c}^P(z,\tilde{b}_m,b_p) = c^{DP}(z,\tilde{b}_m) + \Delta^{DP}(z,b_m,b_p)$ with $\Delta^{DP}(z,b_m,b_p) \geq 0$ since $c^P(z,b_m,b_p) \geq c^{DP}(z,b_m,b_p)$. Hence, (C.4) holds given the strict concavity of $u$.

Second, suppose that $c^P(z, b_m, b_p) < c^{DP}(z, b_m, b_p)$. I distinguish the case of repayment from *partial* default. First, consider that repayment is optimal. Since $c^P(z, b_m, b_p) < c^{DP}(z, b_m, b_p)$, the optimality of repayment implies that $\mathbb{E}_{z'|z}V(z', b'_m, b'_p) > \mathbb{E}_{z'|z}V^{RP}(z')$. This is a contradiction as $V^P(z', b'_m, b'_p) \leq V^P(z', 0, 0)$ and $V^{DP}(z', b'_m) \leq V^{DP}(z', 0)$ for all $(b'_m, b'_p) \leq 0$ and all $z'$ under Proposition C.1. Thus, $\mathbb{E}_{z'|z}V(z', b'_m, b'_p) \leq \mathbb{E}_{z'|z}V^{RP}(z')$ and repayment cannot be optimal. Second, consider that a *partial* default is optimal. From the previous case, default remains optimal as long as $c^P(z, \tilde{b}_m, b_p) < c^{DP}(z, \tilde{b}_m, b_p)$. However, as $\Delta^{DP}(z, \tilde{b}_m, b_p) - \Delta^{DP}(z, b_m, b_p) \geq 0$, it can be that $c^P(z, \tilde{b}_m, b_p) \geq c^{DP}(z, \tilde{b}_m, b_p)$ and repayment becomes optimal again. Thus, *partial* default incentives increase in $b_m$. $\square$

The proof of Proposition 3 relies on the two debt thresholds shown in Proposition 1, the monotonicity of the default policies shown in Proposition C.2 as well as equations (5)-(6).

**Proposition 3.** *$q_m(z, b'_m, b'_p)$ is increasing in $(b'_m, b'_p)$ and $q_p(z, b'_m, b'_p)$ is increasing in $b'_p$. Moreover, $q_p(z, b'_m, b'_p)$ is increasing in $b'_m$ if $b'_m < b^{**}_m$ and decreasing in $b'_m$ if $b'_m \geq b^*_m$ .*

*Proof.* The private bond price depends on the two default policies as one can see in (5). For the private debt, the monotonicity follows from the fact that both $D^{DP}(z', b'_m, b'_p)$ and $D^{DF}(z', b'_m, b'_p)$ decrease in $b'_p$ as shown in Proposition C.2. For the multilateral debt, if $b'_m \geq b^*_m$, there is no *full* default as shown in Proposition 1. As a result, the private bond price decreases in $b'_m$ as $D^{DP}(z', b'_m, b'_p)$ increases in $b'_m$ following Proposition C.2. Conversely, if $b'_m < b^{**}_m$, there is no *partial* default. Thus, the private bond price increases in $b'_m$ as $D^{DF}(z', b'_m, b'_p)$ decreases in $b'_m$ following Proposition C.2.

The multilateral bond price depends on the *full* default policy and $q^{DF}_m(z', b'_m, b'_p)$ as one can see in (6). Following Proposition C.2, $D^{DF}(z', b'_m, b'_p)$ decreases in $(b'_m, b'_p)$. As $\eta > 0$, $q^{DF}_m(z', b'_m, b'_p) \geq q^{DF}_m(z', \tilde{b}'_m, b'_p) \geq 0$ for $\tilde{b}'_m < b'_m < b^*_m$. Inequalities are not strict as market re-entry may not be optimal. This together with the monotonicity of $D^{DF}(z', b'_m, b'_p)$ in $(b'_m, b'_p)$ implies that $q_m(z', b'_m, b'_p)$ is increasing in $(b'_m, b'_p)$. $\square$

# D Numerical Solution

In this section, I present the different value functions, policies and prices after taking the expectations over the utility shock $\boldsymbol{\epsilon}$. I then describe how the model is solved.

The use of extreme value shocks simplifies the computation of the model. Following Rust (1988) and Dvorkin et al. (2021), the continuation value upon repayment is given by

$$\overline{V}(z, b^i_m, b^i_p) = \omega \ln \left\{ \left( \sum_{j=1}^{\mathcal{J}} \exp(u(c_{i,j}(z)) + \beta \mathbb{E}_{z'|z} \overline{V}(z', b^j_m, b^j_p))^{\frac{1}{\omega\nu}} \right)^{\nu} \right. \tag{D.1}$$

$$
\begin{aligned}
&+ \left( \exp(u(y^{DP}(z) + (1-\delta+\delta\kappa)b_m^i) + \beta\mathbb{E}_{z'|z}\overline{V}^{RP}(z', \delta b_m^i, b_p^i)) \right)^{\frac{1}{\omega}} \\
&+ \left( \exp(u(y^{DF}(z)) + \beta\mathbb{E}_{z'|z}\overline{V}^{RF}(z', b_m^i, b_p^i)) \right)^{\frac{1}{\omega}} \Bigg\}
\end{aligned}
$$

$$
\begin{aligned}
\text{s.t. } c_{i,j}(z) = y(z) + [1-\delta+\delta\kappa]\,(b_m^i + b_p^i) - \\
\overline{q}_m(z, b_m^j, b_p^j)(b_m^j - \delta b_m^i) - \overline{q}_p(z, b_m^j, b_p^j)(b_p^j - \delta b_p^i) - \varpi(b_m^j, b_p^j).
\end{aligned}
\tag{D.2}
$$

The probability of choosing the portfolio $(b_m^j, b_p^j)$ in the state $(z, b_m^i, b_p^i)$ is given by

$$
\overline{\overline{B}}(b_m^j, b_p^j; z, b_m^i, b_p^i) = \frac{\exp\left(u(c_{i,j}(z)) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}}{\sum_{k=1}^{\mathcal{J}} \exp\left(u(c_{i,k}(z)) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b_m^k, b_p^k)\right)^{\frac{1}{\omega\nu}}}. \tag{D.3}
$$

The probability of a *partial* and *full* default are respectively

$$
\begin{aligned}
\overline{\overline{D}}^{DP}(z, b_m^i, b_p^i) &= \frac{\mathcal{X}(z, b_m^i, b_p^i)}{\mathcal{X}(z, b_m^i, b_p^i) + \mathcal{Y}(z, b_m^i, b_p^i) + \mathcal{Z}(z, b_m^i, b_p^i)}, \\
\overline{\overline{D}}^{DF}(z, b_m^i, b_p^i) &= \frac{\mathcal{Y}(z, b_m^i, b_p^i)}{\mathcal{X}(z, b_m^i, b_p^i) + \mathcal{Y}(z, b_m^i, b_p^i) + \mathcal{Z}(z, b_m^i, b_p^i)},
\end{aligned}
$$

where

$$
\begin{aligned}
\mathcal{X}(z, b_m^i, b_p^i) &= \exp\left(u(y^{DP}(z) + (1-\delta+\delta\kappa)b_m^i) + \beta\mathbb{E}_{z'|z}\overline{V}^{RP}(z', \delta b_m^i, b_p^i)\right)^{\frac{1}{\omega}}, \\
\mathcal{Y}(z, b_m^i, b_p^i) &= \exp\left(u(y^{DF}(z)) + \beta\mathbb{E}_{z'|z}\overline{V}^{RF}(z', b_m^i, b_p^i)\right)^{\frac{1}{\omega}}, \\
\mathcal{Z}(z, b_m^i, b_p^i) &= \left( \sum_{k=1}^{\mathcal{J}} \exp\left(u(c_{i,k}(z)) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b_m^k, b_p^k)\right)^{\frac{1}{\omega\nu}} \right)^{\nu}.
\end{aligned}
$$

The value of renegotiation after a *partial* default is given by

$$
\begin{aligned}
\overline{V}^{RP}(z, b_m^i, b_p^i) = &\omega\phi \ln \Bigg\{ \Bigg( \sum_{j, \tau_j \geq 0, b_m^j = \delta b_m^i} \exp\left(u(c_{i,j}(z, W_{l,p}^{RP}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}} \Bigg)^{\nu} \\
&+ \exp\left(u(y^D(z) + (1-\delta+\delta\kappa)b_m^i) + \beta\mathbb{E}_{z'|z}\overline{V}^{RP}(z', \delta b_m^i, b_p^i)\right)^{\frac{1}{\omega}} \Bigg\} \\
&+ \omega(1-\phi) \ln \Bigg\{ \Bigg( \sum_{j, \tau_j \geq 0, b_m^j = \delta b_m^i} \exp\left(u(c_{i,j}(z, W_{b,p}^{RP}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}} \Bigg)^{\nu}
\end{aligned}
\tag{D.4}
$$

$$+ \exp\left(u(y^D(z) + (1-\delta+\delta\kappa)b^i_m) + \beta\mathbb{E}_{z'|z}\overline{V}^{RP}(z', \delta b^i_m, b^i_p)\right)^{\frac{1}{\omega}}\Bigg\}$$

$$\text{s.t. } c_{i,j}(z, W_p) = y(z) + [1-\delta+\delta\kappa]\, b^i_m - W_p - \overline{q}_p(z, b^j_m, b^j_p)b^j_p - \varpi(b^j_m, b^j_p).$$

The related probability of accepting a restructuring offer for $k \in \{l, b\}$ is

$$\overline{\overline{A}}^{RP}(z, b^i_m, b^i_p, W^{RP}_{k,p}) = \frac{\left(\sum_{j,\tau_j\geq 0, b^j_m=\delta b^i_m} \exp\left(u(c_{i,j}(z, W^{RP}_{k,p}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b^j_m, b^j_p)\right)^{\frac{1}{\omega\nu}}\right)^{\nu}}{\left(\sum_{j,\tau_j\geq 0, b^j_m=\delta b^i_m} \exp\left(u(c_{i,j}(z, W^{RP}_{k,p}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b^j_m, b^j_p)\right)^{\frac{1}{\omega\nu}}\right)^{\nu} + \boldsymbol{x}(z, b^i_m, b^i_p)},$$

where I distinguish $\boldsymbol{x}(\cdot)$ from $\mathcal{X}(\cdot)$ given the different output penalty upon the continuation of a *partial* default

$$\boldsymbol{x}(z, b^i_m, b^i_p) = \exp\left(u(y^D(z) + (1-\delta+\delta\kappa)b^i_m) + \beta\mathbb{E}_{z'|z}\overline{V}^{RP}(z', \delta b^i_m, b^i_p)\right)^{\frac{1}{\omega}}.$$

The value of renegotiation after a *full* default is given by

$$\begin{aligned}\overline{v}^{RF}(z, b^i_m, b^i_p) =& \omega\phi \ln\Bigg\{\Bigg(\sum_{j,\tau_j\geq 0, b^j_m=0} \exp\left(u(c_{i,j}(z, W^{RF}_{l,p}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b^j_m, b^j_p)\right)^{\frac{1}{\omega\nu}}\Bigg)^{\nu} \\ &+ \exp\left(u(y^D(z)) + \beta\mathbb{E}_{z'|z}\overline{V}^{RF}(z', b^i_m, b^i_p)\right)^{\frac{1}{\omega}}\Bigg\} \\ &+ \omega(1-\phi) \ln\Bigg\{\Bigg(\sum_{j,\tau_j\geq 0, b^j_m=0} \exp\left(u(c_{i,j}(z, W^{RF}_{b,p}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b^j_m, b^j_p)\right)^{\frac{1}{\omega\nu}}\Bigg)^{\nu} \\ &+ \exp\left(u(y^D(z)) + \beta\mathbb{E}_{z'|z}\overline{V}^{RF}(z', b^i_m, b^i_p)\right)^{\frac{1}{\omega}}\Bigg\} \\ &\text{s.t. } c_{i,j}(z, W_p) = y(z) + (1-\delta+\delta\kappa+\delta\overline{q})\Psi b^i_m - W_p - \overline{q}_p(z, b^j_m, b^j_p)b^j_p - \varpi(b^j_m, b^j_p).\end{aligned} \tag{D.5}$$

The related probability of accepting a restructuring offer for $k \in \{l, b\}$ is

$$\overline{\overline{A}}^{RF}(z, b^i_m, b^i_p, W^{RF}_{k,p}) = \frac{\left(\sum_{j,\tau_j\geq 0, b^j_m=0} \exp\left(u(c_{i,j}(z, W^{RF}_{k,p}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b^j_m, b^j_p)\right)^{\frac{1}{\omega\nu}}\right)^{\nu}}{\left(\sum_{j,\tau_j\geq 0, b^j_m=0} \exp\left(u(c_{i,j}(z, W^{RF}_{k,p}) + \beta\mathbb{E}_{z'|z}\overline{V}(z', b^j_m, b^j_p)\right)^{\frac{1}{\omega\nu}}\right)^{\nu} + \boldsymbol{y}(z, b^i_m, b^i_p)},$$

where I distinguish $\boldsymbol{y}(\cdot)$ from $\mathcal{Y}(\cdot)$ given the different output penalty upon the continuation of a *full* default

$$\boldsymbol{y}(z, b_m^i, b_p^i) = \exp\Big(u(y^D(z)) + \beta \mathbb{E}_{z'|z} \overline{V}^{RF}(z', b_m^i, b_p^i)\Big)^{\frac{1}{\omega}}.$$

The private bond price therefore reduces to

$$\begin{aligned} \overline{q}_p(z, b_m^j, b_p^j) = \frac{1}{1+r} \mathbb{E}_{z'|z} \Bigg[ & \Big(1 - \overline{\overline{D}}^{DP}(z', b_m^j, b_p^j) - \overline{\overline{D}}^{DF}(z', b_m^j, b_p^j)\Big) \times \\ & \Big(1 - \delta + \delta\kappa + \delta \sum_{k=1}^{\mathcal{J}} \overline{q}_p(z', b_m^k, b_p^k) \overline{\overline{B}}(b_m^k, b_p^k; z', b_m^j, b_p^j)\Big) + \\ & \overline{\overline{D}}^{DP}(z', b_m^j, b_p^j) \overline{q}_p^{DP}(z', b_m^j, b_p^j) + \overline{\overline{D}}^{DF}(z', b_m^j, b_p^j) \overline{q}_p^{DF}(z', b_m^j, b_p^j) \Bigg]. \end{aligned} \tag{D.6}$$

with recovery values

$$\begin{aligned} \overline{q}_p^{DP}(z, b_m^i, b_p^i) = \frac{1}{1+r} \mathbb{E}_{z'|z} \big[ & (1 - \phi \overline{\overline{A}}^{RP}(z', \delta b_m^i, b_p^i, W_{l,p}^{RP})) \overline{q}_p^{DP}(z', \delta b_m^i, b_p^i) + \\ & \phi \overline{\overline{A}}^{RP}(z', \delta b_m^i, b_p^i, W_{l,p}^{RP}) \frac{W_{l,p}^{RP}(z', \delta b_m^i, b_p^i)}{-b_p^i} \big], \end{aligned}$$

and

$$\begin{aligned} \overline{q}_p^{DF}(z, b_m^i, b_p^i) = \frac{1}{1+r} \mathbb{E}_{z'|z} \big[ & (1 - \alpha\phi \overline{\overline{A}}^{RF}(z', b_m^i, b_p^i, W_{l,p}^{RF})) \overline{q}_p^{DF}(z', b_m^i, b_p^i) + \\ & \alpha\phi \overline{\overline{A}}^{RF}(z', b_m^i, b_p^i, W_{l,p}^{RF}) \frac{W_{l,p}^{RF}(z', b_m^i, b_p^i)}{-b_p^i} \big]. \end{aligned}$$

Similarly, the multilateral debt price reduces to

$$\begin{aligned} \overline{q}_m(z, b_m^j, b_p^j) = \frac{1}{1+r} \mathbb{E}_{z'|z} \Bigg[ & \Big(1 - \overline{\overline{D}}^{DF}(z', b_m^j, b_p^j)\Big) \times \\ & \Big(1 - \delta + \delta\kappa + \delta \sum_{k=1}^{\mathcal{J}} \overline{q}_m(z', b_m^k, b_p^k) \overline{\overline{B}}(b_m^k, b_p^k; z', b_m^j, b_p^j)\Big) + \\ & \overline{\overline{D}}^{DF}(z', b_m^j, b_p^j) \overline{q}_m^{DF}(z', b_m^j, b_p^j) \Bigg]. \end{aligned} \tag{D.7}$$

with recovery value

$$\overline{q}_m^{DF}(z, b_m^i, b_p^i) = \frac{1}{1+r} \mathbb{E}_{z'|z} \big[ (1 - \alpha \overline{\overline{A}}^{RF}(z', b_m^i, b_p^i, W_l^{RF})) \overline{q}_m^{DF}(z', b_m^i, b_p^i) +$$

$$\alpha \overline{\overline{A}}^{RF}(z', \delta b_m^i, b_p^i, W_l^{RF})(1 - \delta + \delta\kappa + \delta\bar{q})\Psi\big].$$

I solve the model using value function iterations on a discretized grid for output, multilateral and private debts. The process starts with a guess of the value function $\overline{V}$ as well as of the prices $\overline{q}_p$ and $\overline{q}_m$ corresponding to the limit of finite horizon. Given those guesses, I first determine the repayment value. I compute the value for each combination of multilateral and private debts. I also compute the bond choice probability through (D.3).

For the autarky values, I first solve the optimal lenders offer over a W-grid. For each point on the W-grid, I determine the value of reentering the market by means of a grid search.[36] I subsequently generate the values of renegotiation using (D.4)-(D.5) and compute the different borrower's acceptance probabilities.

Having calculated the value under repayment and the value under default, I retrieve the new value of $\overline{V}$ from equation (D.1) and generate the different default probabilities.

With the acceptance probabilities and the lender's offer, I can calculate the recovery price for each debt instrument and for each default case as specified above. Once this is done, I compute the new bond prices $\overline{q}_p$ and $\overline{q}_m$ by means of equations (D.6) and (D.7), respectively.

Subsequently, I compare the initial guesses with the new outcome. I compute the maximal absolute distance between the newly-computed and the guessed prices $\overline{q}_p$ and $\overline{q}_m$. The same is done for the value $\overline{V}$. If convergence is not attained, guesses are updated using a relaxation parameter and the whole process starts again.

Once the model is solved, I run simulations for 2000 countries and 600 years. The first 200 years are discarded to ensure that the initial conditions do not matter. All model-generated moments are computed as averages across countries. Business cycle moments are HP filtered with a smoothing parameter of 6.25.

[36] For computational efficiency, this step takes place at the same stage as the grid search for the debt in repayment.