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

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**Abstract**

Sovereign countries do not necessarily repay all its creditors. There is a clear pecking order in which official multilateral lenders – i.e. mainly the International Monetary Fund and the World Bank – are given priority in repayment. Yet, this preferred status is a market practice and is not legally binding. This paper documents the source and the consequences of the *de facto* seniority of official multilateral lenders. Empirically, I present evidence that defaults involving such lenders are infrequent, last relatively longer and are associated with greater private creditors' losses. To rationalize those findings, I build a model of endogenous defaults and renegotiations with heterogenous lenders. The key component behind the *de facto* seniority is the typical policy of non-toleration of arrears adopted by official multilateral lenders. Combined with the default penalty, this policy rationalizes the aforementioned empirical facts and generates important spillovers on other creditors. The borrower values the use of official multilateral debt and would not necessarily prefer other seniority regimes.

**Keywords:** sovereign debt, debt overhang, default, heterogenous creditors, renegotiation

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

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# 1 Introduction

Excluding advanced economies, debt from (official) multilateral lenders – i.e. mainly the International Monetary Fund (IMF) and the World Bank (WB) – represents more than 35% of the total sovereign debt and is beside bonds the second largest category of sovereign borrowing.[1] It has the peculiarity that multilateral lenders are paid ahead of other creditors and, when payments are deferred, are usually repaid in full (Schlegl et al., 2019). Yet, legally speaking, nothing enforces this pecking order. In other words, market participants 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 literature on sovereign debt and default has generally overlooked this implicit seniority structure modelling defaults as symmetric across creditors. The present study seeks to fill this gap. It investigates the source and the consequences of the preferred creditor status of multilateral lenders.

I begin this inquiry by establishing new empirical facts on multilateral creditors based on 187 episodes of external debt's default from 1970 to 2014.[2] First and foremost, defaults with multilateral creditors are infrequent. In the sample at hand, such events represent around 18% of all reported episodes. Second, they usually last longer than other defaults taking roughly 9 years to be resolved. In opposition, defaults on other types of creditors last on average 3 years. Third, I find that for default episodes with multilateral creditors, the average haircut on private creditors raises to 59%, while it falls to 33% otherwise. Finally, multilateral lenders always lend at preferential rates. All these facts hold after controlling for the default's and the country's characteristics.

Having identified the main empirical facts linking defaults with multilateral creditors, I build a model capable of rationalizing them. For this purpose, I augment the standard model of Eaton and Gersovitz (1981) with heterogenous lenders and endogenous restructurings. I assume the existence of a continuum of competitive private lenders and one multilateral lender. There is limited enforcement in repayment and the sovereign can decide to default either on private creditors – *partial* default – or on both creditors – *full* default. Each default is followed by a complete market exclusion and an output penalty. In a *partial* default, the sovereign continues to service the multilateral debt while being in autarky.

A central idea in my theory is that the multilateral lender has a greater enforcement power than the private lenders. On the one hand, defaulting on the multilateral debt entails a greater output penalty than defaulting on the private debt. On the other hand, the

[1] See Appendix A for a breakdown of the world sovereign debt between 1970 and 2020.

[2] Default's dates come from Asonuma and Trebesch (2016) and haircuts from Cruces and Trebesch (2013). I then identify the creditors involved in each default using the database of Beers et al. (2022).

multilateral lender does not lend when the sovereign is in arrears and the outstanding multilateral debt has not been repaid in full.[3] This second element corresponds to a policy of non-toleration of arrears characteristic of the IMF's and the WB's practice. The greater enforcement power implies that the multilateral debt is *de facto* senior to private debt.[4] The policy of non-toleration of arrears safeguards the preferential rate of multilateral lending, whereas the output penalty controls the frequency of multilateral debt's defaults.[5]

The key feature in the model is that the *de facto* seniority of multilateral debt generates important spillovers on private lenders. On the one hand, the private debt is subordinated meaning that private creditors receive what is left after the full repayment of multilateral debt. Hence, in a *full* default, the level of multilateral debt directly affects the private debt's recovery value. On the other hand, a larger stock of multilateral debt reduces the value of a *partial* default as it raises the multilateral debt servicing costs in autarky. Thus, while the multilateral debt raises the subordination risk of private liabilities, it can reduce the default risk up to a certain point. The net effect depends on the size of the multilateral debt.

Given this, the *de facto* seniority impacts the sovereign borrowing, the default's decision and the restructuring's process. In terms of borrowing, the multilateral debt is less sensitive to the default risk but at the cost of subordinating private debt. Thus, more multilateral debt may or may not increase the marginal benefit of debt issuance. In the former case there is a seniority benefit, while in the latter a seniority cost to the repayment incentive. I find that the seniority benefit usually manifests when the stock of multilateral debt is relatively small. In addition, the reduced sensitivity to the default risk renders the multilateral debt less prone to dilution than the private debt. The possibility to dilute private debt reduces the marginal cost of debt issuance as it reduces the future debt burden. This is what I call the subordination benefit. There is therefore a tradeoff between insurance and incentive shaping the seniority structure.

Regarding the default's decision, there are two effects. On the one hand, more multilateral debt reduces the value of a *partial* default owing to larger multilateral debt servicing costs in autarky. As a result, such type of default becomes less attractive. On the other hand, a larger portion of multilateral debt increases the probability of *full* default. The default's decision is therefore shaped by the level of punishment on the different types of defaults and the level of multilateral indebtedness relative to the stock of private debt.

Finally, regarding the debt restructuring's process, the model predicts larger haircuts and longer default's durations when the multilateral lender is involved. This is a consequence

[3] In a default, there is no accumulation of arrears. Missed coupon payments are forgone.

[4] We say that seniority is *de jure* when enforced by *ex ante* contractual requirements. In my analysis, seniority is *de facto* as it emerges from *ex post* sanctions.

[5] Notice that I abstract from conditionality in my analysis which is another feature of multilateral lending.

of the non-toleration of arrears which renders restructurings more costly. In particular, the sovereign 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 sovereign's value of restructuring which in turns increases both the private creditors' loss and the default's length. Thus, what is at the source of the *de facto* seniority also explains the greater default's lengths and haircuts observed in the data.

The model is calibrated to match moments related to Argentina. Except for the share of *full* defaults, none of the aforementioned empirical facts is directly targeted. I find that the model fits the data particularly well. It is capable of generating the observed default's lengths and haircuts depending on the different types of creditors involved. Nevertheless, it somewhat underestimates the average duration in a *full* default. The larger haircut can be directly attributed to the two building blocks of the policy of non-toleration of arrears: the full repayment of the multilateral debt and the inability to issue new multilateral debt when clearing arrears. The longer duration mainly comes from a greater private debt accumulation triggered by the aforementioned policy.

I subsequently conduct a series of counterfactual analyses. For instance, I study what happens when one introduces a *de jure* seniority or a *pari passu* clause. Under a *de jure* seniority, the sovereign adopts a more reckless debt management with a larger debt ratio and a larger default rate than in the benchmark model. This is because the multilateral debt trades at the risk-free rate irrespective of the default rate. In opposition, under a *pari passu* clause, debt accumulation is more disciplined than in the benchmark model. This is because the default rate largely impacts the multilateral debt price. Hence, reinforcing the seniority of the multilateral debt seems detrimental to fiscal discipline.

Moreover, for those two exercises, I find welfare losses for the sovereign especially in regions of debt crises. A *de jure* seniority is too strict and does not allow for full debt repudiation, while a *pari passu* clause drastically limits the last-resort aspect of the multilateral debt. Hence, the sovereign values the *de facto* seniority of multilateral debt and would not necessarily prefer other seniority regimes.

The paper is organized as follows. Section 2 reviews the existing literature. Section 3 introduces the conventions on sovereign debt seniority. Section 4 presents the empirical analysis. Section 5 describes the economic environment of the model. Sections 6 and 7 present the decisions regarding repayment and renegotiation, respectively. Section 8 characterizes the optimal seniority structure. Sections 9 and 10 present the calibration and the result of the quantitative analysis, respectively. Finally, Section 11 concludes.

## 2 Literature Review

The paper combines elements of the empirical literature about sovereign debt with elements of the theoretical literature about sovereign debt, seniority and official lending.

In the empirical literature on sovereign debt, Benjamin and Wright (2013) are one of the first to document the main statistics on sovereign debt renegotiations.[6] Building a more comprehensive dataset, Cruces and Trebesch (2013) refine the previous analysis and present evidence that haircuts impact the bond spreads and the market exclusion's length. Similarly, Asonuma and Trebesch (2016) show that preemptive restructurings are associated with shorter durations and lower creditors' losses relative to post-default restructurings. In addition, Asonuma and Joo (2020) present evidence that the economic conditions on the side of foreign creditors largely influence the length and the terms of a restructuring. Closer to my analysis, Asonuma et al. (2023) document that haircuts are greater on short-term than on long-term bondholders. I contribute to this literature by showing that haircuts and default duration also depend on the type of creditors involved in the default episode.

The starting point of the theoretical literature on sovereign debt is the study of Eaton and Gersovitz (1981), Aguiar and Gopinath (2006) and Arellano (2008).[7] To replicate the characteristics of emerging economies, the original model has been expanded in five main dimensions. First, Hatchondo and Martinez (2009) and Chatterjee and Eyigungor (2012) introduced long-term debt. Subsequently, Arellano and Ramanarayanan (2012) and Niepelt (2014) included mixed maturities. Third, Mendoza and Yue (2012) endogenized the income process and the default cost. Fourth, Arellano et al. (2023) introduced partial defaults to account for arrears accumulation. Finally, Bi (2008), Yue (2010) and Benjamin and Wright (2013) endogenized the renegotiation process assuming either a cooperative or a non-cooperative game between the lenders and the borrower.[8] All aforementioned studies assume that haircuts and default durations are symmetric across creditors. This paper first documents that this assumption is not supported by the data. It then introduces two creditors with different enforcement power to address this matter.

The paper is further related to the literature on the seniority structure of sovereign debt. Erce and Mallucci (2018) present evidence that countries discriminate between domestic and foreign creditors when defaulting. Among foreign creditors, Schlegl et al. (2019) show that

[6] See also the earlier work of Lindert and Morton (1989), Rieffel (2003), Finger and Mecagni (2007), Díaz-Cassou et al. (2008), Sturzenegger and Zettelmeyer (2008) and Trebesch (2011).

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

[8] Their framework has been recently extended by Dvorkin et al. (2021) and Mihalache (2020) to account for mix maturities, by Asonuma and Trebesch (2016) to distinguish between preemptive and post-default restructurings, by Asonuma and Joo (2020) to introduce risk-averse creditors and by Fourakis (2021) to account for reputation.

the seniority is mostly *de facto* and that multilateral lenders enjoy the highest seniority. Theoretical models only partially addressed this issue, though. While many studies take the seniority structure as given,[9] few explicitly model the mechanism leading to a seniority structure of sovereign debt. Chatterjee and Eyigungor (2015) define senior tranches as the tranches which were issued first. Dellas and Niepelt (2016) and Ari et al. (2018) generate an implicit seniority structure by means of the default penalty. Conversely, Bolton and Jeanne (2009) develop a model in which the *de facto* seniority emerges from the renegotiation process. Finally, Cordella and Powell (2021) generate a preferred creditor status through commitment in lending. I focus on the ability of the lenders to enforce repayment through the output penalty and the renegotiation process. This generates a tradeoff between multilateral and private debts similar to the one between short-term and long-term debts in Arellano and Ramanarayanan (2012) and Niepelt (2014). The main difference is that more multilateral debt – unlike short-term debt – does not always increase the incentive to repay.

Finally, the paper also connects to the literature on official lending. Building on Ábrahám et al. (2019), Liu et al. (2020) find that the seniority of a multilateral lending institution is not necessarily preferable to a *pari passu* regime.[10] In opposition, I show that the seniority structure of sovereign debt is necessary to sustain the last-resort function of multilateral lending. Such function is important as it often relates to the catalytic effect of multilateral lending. Corsetti et al. (2006), Morris and Shin (2006) and Rochet and Vives (2010) show theoretically that the provision of multilateral debt can bolster the inflow of private funds. 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.[11] For instance, extending the framework of Corsetti et al. (2006), Krahnke (2020) shows that the *de facto* seniority of the IMF can lead to a crowding-out of private funds if the IMF support is sufficiently large. I find a similar effect. In addition, similar to Cordella and Powell (2021), I stress the importance of the policy of non-toleration of arrears in shaping the *de facto* seniority. Finally, I show that different seniority regimes imply different behaviors of debt accumulation and default.

[9] For example, Hatchondo et al. (2017) consider the case of adding a non-defaultable bonds beside traditional defaultable bonds. Similarly, Gonçalves and Guimaraes (2014) analyze the link between fiscal policy and sovereign default taking the seniority structure as given. Analysing the interaction between default, private and multilateral debt, Boz (2011) and Fink and Scholl (2016) adopt the same modelling strategy.

[10] Relatedly, focusing on self-fulfilling debt crises, Galli (2021) argues that the seniority of the IMF can give rise to more coordination failures among private lenders than a *pari passu* clause.

[11] See notably Saravia (2013), Erce and Riera-Crichton (2015), Gehring and Lang (2018) and Krahnke (2020) for empirical analyses and Zwart (2007) and Krahnke (2020) for theoretical ones.

# 3 Multilateral Lenders and Seniority

This section reviews the existing conventions on sovereign debt seniority. 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 reimbursements of sovereign debt and offers little guidance on the repayment priority of creditors.[12] Furthermore, there exists no supranational entity capable of prosecuting defaults or supervising restructurings of sovereign debt.[13] Thus, the seniority structure of sovereign debt is mostly implicit (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 structure relates to *ex ante* enforceable legal clauses that give priority to some creditors. The European Stability Mechanism (ESM), for example, has a *de jure* seniority with respect to the market, meaning that countries obtaining financial support from that institution are legally compelled to prioritize the ESM's repayment.[14] In opposition, a *de facto* seniority structure 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.

Yet, it is the multilateral lending institutions such as the IMF and the WB which enjoy *de facto* seniority.[15] Neither the IMF's nor the WB's Articles of Agreement mention any seniority or preferred creditor status (Raffer, 2009). However, the market participants acknowledge and respect this implicit seniority structure (Standard & Poor's, 2000). That is, those lending institutions are paid ahead of other creditors and, when payments are deferred, are usually repaid in full (Schlegl et al., 2019). As one can see in Figure A.3 in Appendix A, the IMF and the WB never represented more than 4% of the total amount of debt in default over the years. Similarly, from Figure A.4, the two institutions combined never accounted for more than 11% of the countries in default. None of the other reported creditors such as the Paris Club and other official creditors has a better record.

[12] Even though there exist eminent litigation cases in which creditors successfully enforced repayments (e.g. Bank and Trust Company against the Central Bank of Brazil or Elliott Associates against the Republic of Panama and Banco de la Nación in Peru), few cases managed to obtain full repayment. The existing legal framework therefore remains relatively limited in enforcing debt repayments (Panizza et al., 2009). Plus, it provides no explicit priority system for creditors involved in restructurings (Martha, 1990; Gelpern, 2004). Nevertheless, it has gained in importance since the 1990s with notably the development of specialized distressed debt funds and the use of *pari passu* clauses (Schumacher et al., 2021).

[13] See Krueger (2001) for one of the most influential proposals on that matter.

[14] The only exception relates to the program with Spain which was not senior only because of a transitional agreement with the European Financial Stability Facility.

[15] This is a well established fact documented by numerous studies, explicitly supported by the Paris Club and repeatedly acknowledged by the main rating agencies. See notably Jeanne and Zettelmeyer (2001), Roubini and Setser (2003), Gelpern (2004), Raffer (2009), Schadler (2014) and Schlegl et al. (2019).

Interestingly, the aforementioned international financial institutions did not initially endorse their *de facto* seniority status (Martha, 1990; Raffer, 2009). Regarding the IMF, many of its loans were restructured jointly with other types of debts in the 1960s (Beers and Mavalwalla, 2018). Subsequently, in the 1970s and until the late 1980s, multiple countries started to accumulate substantial arrears with respect to crisis loans the IMF provided (Reinhart and Trebesch, 2016; Schlegl et al., 2019). This resulted to the official endorsement of the preferred creditor status at the end of the 1980s (IMF, 1988). Regarding the WB, the International Bank for Reconstruction and Development's (IBRD) and the International Development Association's (IDA) loans were initially meant to be subordinated to private claims (Raffer, 2009). Moreover, the major credit agencies waited more than a decade after the WB's creation to attribute it the highest rating.

This implicit seniority structure provides an, albeit imperfect, shelter to multilateral institutions, allowing them to provide loans to countries with major economic difficulties at preferential rates (Fischer, 1999). 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.[16] First, it does not tolerate defaults on official creditors and forbids the use of funds to member states with arrears to the IMF (IMF, 1989; IMF, 2015). More precisely, countries need to clear arrears to regain access to IMF lending. Second, if a sovereign receives support from an IMF program and defaults on its private creditors, the program should, absent immediate corrective actions by the authorities, 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).[17]

When building the model, I will assume that the multilateral lenders adopt a (simplified) version of the aforementioned policy of non-toleration of arrears. In particular, the multilateral lender refrains from lending into arrears as in Cordella and Powell (2021) and requests full repayment. As one will see, this safeguards the preferential rates of multilateral lending. It is also at the source of a longer defaults and greater private creditors' losses.

[16]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.

[17]See for example the case of Somalia in March 2020 and Sudan in March 2021 which both could re-access the WB after successfully clearing their arrears and conducting requested reforms.

# 4 Empirical Facts

In this section, I introduce the main empirical regularities linking defaults with multilateral creditors.[18] My analysis relies on 187 default episodes from 1970 to 2014, which all involve external debt and private creditors.

Data on default durations and haircuts come from Asonuma and Trebesch (2016) and Cruces and Trebesch (2013), respectively. I then identify the different creditors involved in each default episode using the database of Beers et al. (2022). In particular, I focus on multilateral lenders which consist of the IMF, the IBRD and the IDA. A default episode *with* multilateral lenders consists of an episode in which a country defaults on at least one of the these three lending institutions.[19] The alternative case corresponds to a default *without* multilateral lenders. Appendix B gives a detailed overview of the data used in this section. In particular, Table B.1 presents the sample used and Table B.2 specifies the source.

Table 1: Duration and Haircut Statistics

| | Mean | Median | Min | Max | Std. Dev. | Obs. |
|---|---|---|---|---|---|---|
| Default Duration (year) | | | | | | |
| Overall | 3.6 | 1.6 | -0.2 | 27.4 | 4.71 | 187 |
| With multilateral creditors | 8.5 | 7.6 | 0.3 | 27.4 | 6.98 | 33 |
| Without multilateral creditors | 2.6 | 1.3 | -0.2 | 18.2 | 3.25 | 154 |
| | | | | | | |
| SZ Haircut on Private Lenders (%) | | | | | | |
| Overall | 37.5 | 32.5 | -9.8 | 97.0 | 27.93 | 187 |
| With multilateral creditors | 59.0 | 55.2 | 12.3 | 97.0 | 27.68 | 33 |
| Without multilateral creditors | 32.9 | 29.0 | -9.8 | 97.0 | 25.83 | 154 |

*Note*: The table depicts the default duration in years and the haircut on private lenders in percent for all the defaults in the sample (overall) and separately for defaults with and without multilateral lenders. SZ haircuts are computed according to Sturzenegger and Zettelmeyer (2008). The negative default duration corresponds to the preemptive restructuring of Nicaragua in 1982.

*Source*: Default dates are from Asonuma and Trebesch (2016) and the haircuts are from Cruces and Trebesch (2013). See Appendix B for more details.

Table 1 presents the main figures related to the default's duration and private creditors' haircut. For each statistic, I distinguish between defaults with and without multilateral lenders. Overall, I identify four main empirical facts. The first one states that defaults with multilateral creditors are infrequent. Out of the 187 default episodes presented here only 33 are with multilateral creditors.[20]

[18] The analysis in this section and in Appendix C is not necessarily causal.

[19] 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 Cruces and Trebesch (2013).

[20] See also the discussion in Section 3 and the related Figures A.3 and A.4 in Appendix A.

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

In addition, I find that sovereign defaults take between 3 and 4 years to be resolved. More importantly, if one conditions the length on the type of creditors involved, a default with multilateral creditors takes roughly 9 years to be resolved. In opposition, a default without such lenders takes on average 3 years to be resolved. Looking at the median the wedge between the two statistics is even larger. Hence, defaults with multilateral creditors are associated with a tripling of the length of default on average. The second fact is thus:

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

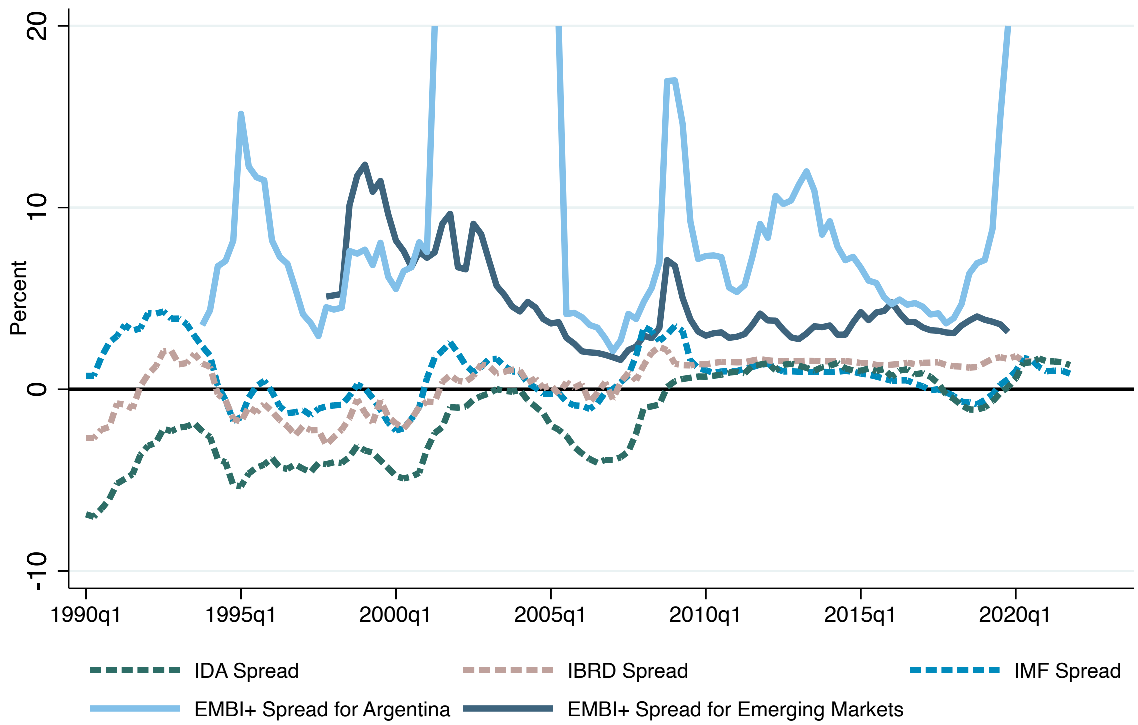
To go beyond the analysis of simple stylised facts, I conduct a more comprehensive econometric analysis. However, for the continuity of the argument, I only highlight here the main findings. The detailed regression analysis is presented in Appendix C. To gauge the robustness of Fact II, I conduct two main exercises: ordinary least squares (OLS) regressions and Cox proportional hazard (Cox) duration regressions. There I control for the specificity of each default (i.e. amount restructured, presence of a Brady deal and private creditor's losses) but also for the economic and political stands of the countries in default.

The outcome of the OLS duration regressions is depicted in Table C.3. There is a strong and positive association between defaults with multilateral creditors and the length of the default duration. Particularly, a default with multilateral debt is associated with a default's duration between 3 and 7 additional years depending on the model's specification. I draw similar conclusions from the outcome of the Cox model presented in Table C.4. Notably, a default with multilateral creditors is associated with a reduction of the probability of exiting default between 36% and 69% depending on the model's specification. In view of those results, it seems that this newly established fact is relatively robust. Controlling for the specificity of each default episode and the countries' characteristics does not undermine the association between the default's length and multilateral creditors.

The second part of Table 1 presents the private creditors' haircut computed according to Sturzenegger and Zettelmeyer (2008) (henceforth SZ). Private creditors' haircuts are 38% on average. However, for default episodes with multilateral creditors, the average haircut raises to 59%, while it falls to 33% otherwise. Looking at the median the wedge between the two statistics is of similar magnitude. This leads to the third empirical fact:

**Fact III.** *A default with multilateral lenders is associated with larger private creditors' losses.*

However, the association between large haircuts and multilateral creditors might simply be a by-product of other factors not necessarily related to the creditor's identity. Thus, I conduct an econometric analysis to disentangle the forces at play. For this purpose, I run OLS regressions controlling for the specificity of each default episode (i.e. amount restructured, presence of a Brady deal and the duration) as well as the economic and political situations of each country in default, like I did for Fact II.




*Note*: The figure depicts the spread for different types of sovereign debt. The EMBI+ spread series track the spread on emerging market fixed and floating-rate sovereign debt instruments. The EMBI+ series 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 IBRD spread corresponds to the lending rate minus the yield on 1-year US government bonds. The IDA spread corresponds to the service charge minus the yield on 1-year US government bonds.

*Source*: See Appendix B.

Figure 1: Spreads on Sovereign Debt

Table C.5 in Appendix C presents the results of the haircut regressions. The coefficient related to multilateral lenders is economically important although the statistical significance is less pronounced than for Fact II. Defaulting on such creditors is associated with an increase of the private creditors' haircut between 8 and 15 percentage points for the SZ haircut depending on the model's specification. I therefore conclude that the third empirical fact is relatively robust as well. Controlling for specific components such as the default duration, IMF programs, WB loans or the HIPC initiative does not undermine the association between the private creditors' loss and multilateral creditors.[21]

Finally, the last empirical fact relates to the lending conditions. While private creditors can request substantial risk premia, multilateral creditors always provide funds at preferential rates. The fourth and last empirical fact is thus

**Fact IV.** *Multilateral lenders lend at rates close to the risk-free rate.*

Figure 1 depicts the spread of the IMF adjusted rate of charge as well as the IBRD lending rate and the IDA service charge with respect to the yield on 1-year US government bonds. It also presents the EMBI+ spread for Argentina and emerging economies to have a sense of the premium charged by the market in general. As it is clear, multilateral lenders always charge a rate close to the risk-free one.[22] Boz (2011) already highlighted this particularity for the IMF lending.

# 5 Environment

Having established new empirical facts, the following sections aim at building a model capable of rationalizing them. I consider a small open economy in infinite discrete time $t = \{0, 1, \dots\}$ with a single homogenous good. The small open economy is populated by a benevolent government a continuum of competitive private lenders and one (official) multilateral lender.

The sovereign acts as a representative agent and 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, I assume that the sovereign is relatively impatient meaning that $\beta < 1/(1+r)$ where $r$ is the exogenous risk-free rate. Each period the sovereign receives an exogenous endowment, $y(z)$, which follows a first-order Markov process with a compact support $Z = \{z_1, z_2, ..., z_n\}$.

The sovereign faces two funding opportunities. On the one hand, it can issue private debt, $b'_p$, at the unit price $q_p(z, b'_m, b'_p)$. On the other hand, it can issue multilateral debt, $b'_m$, at the unit price $q_m(z, b'_m, b'_p)$. I consider that $b_i < 0$ denotes a debt, while $b_i > 0$ denotes an asset for all $i \in \{m, p\}$. Both types of debt are long-term and follow the structure of Chatterjee and Eyigungor (2012). More precisely, a fraction $1 - \delta$ of the bond portfolio matures every period and the remaining fraction $\delta$ is rolled over and pays a coupon $\kappa$. Both

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

[22] The average IMF, IBRD and IDA spreads are 0.76%, 0.30% and −1.78%, respectively. In opposition, the EMBI+ spread for Argentina and emerging economies amount to and 13.51% and 4.72%, respectively.

types of bonds have the same $(\kappa, \delta)$ and the risk-free return is given by $\bar{q} \equiv \frac{1-\delta+\delta\kappa}{1+r-\delta}$. The financial market is incomplete as bonds do not discriminate the returns across $z$.

There is limited enforcement in repayment. The sovereign has two default options: *partial* or *full*. In the former case, the sovereign solely defaults on its private debt, whereas in the latter case it defaults on its entire debt position.[23] Both types of default are followed by a complete bond market exclusion and an output penalty. I denote $y^{DP}(z)$ and $y^{DF}(z)$ as the endowment upon a *partial* and *full* default, respectively.

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 than the private lenders. First, defaulting on the multilateral debt entails greater output cost – i.e. $y \geq y^{DP} > y^{DF}$. Second, following the discussion in Section 3, the multilateral lender follows a stringent policy of non-toleration of arrears which consists of two main components. First, repayment of outstanding multilateral debt is always in full. Second, the multilateral lender does not provides new debt until arrears have been completely cleared. For tractability, missed coupon payments are nevertheless forgone.

Following Dvorkin et al. (2021), I introduce additive utility shocks for computational reasons. I assume that debt takes values in a discrete support $B_p = \{b_{p,1}, \ldots, b_{p,\mathcal{P}}\}$ with $|B_p| = \mathcal{P}$ for the private debt and $B_m = \{b_{m,1}, \ldots, b_{m,\mathcal{M}}\}$ with $|B_m| = \mathcal{M}$ for the multilateral debt. Define the vectors $\boldsymbol{b}_p$ and $\boldsymbol{b}_m$, where $(b_p^i, b_m^i)$ are the $i$th elements of each vector.

$$\boldsymbol{b}_p = [\underbrace{B_p, \ldots, B_p}_{\mathcal{M}\text{ times}}] \quad \text{and} \quad \boldsymbol{b}_m = [\underbrace{b_{m,1}, \ldots, b_{m,1}}_{\mathcal{P}\text{ times}}, \underbrace{b_{m,2}, \ldots, b_{m,2}}_{\mathcal{P}\text{ times}}, \ldots, \underbrace{b_{m,\mathcal{M}}, \ldots, b_{m,\mathcal{M}}}_{\mathcal{P}\text{ times}}]$$

There is a utility shock vector $\boldsymbol{\epsilon}$ of size $\mathcal{P} \times \mathcal{M} + 2 \equiv \mathcal{J} + 2$, which corresponds to the number of all possible combinations of the entries in $B_p$ and $B_m$ plus two additional elements that accounts for the choices of *partial* and *full* defaults. The random vector is drawn from a multivariate distribution with joint cumulative distribution function $F(\boldsymbol{\epsilon}) = F(\epsilon_1, \epsilon_2, \ldots, \epsilon_{\mathcal{J}}, \epsilon_{\mathcal{J}+1}, \epsilon_{\mathcal{J}+2})$ and joint density function $f(\boldsymbol{\epsilon})$.

In this environment, the sovereign faces two problems. On the one hand, it decides whether to repay or not. This is the repayment problem. On the other hand, under default, the sovereign has to renegotiate its debt. This is the renegotiation problem.

The timing of the model is depicted in Figure 2. In the repayment problem, given the realization of $(z, \boldsymbol{\epsilon})$, the sovereign decides whether to repay or not. If it repays, it maintains its market access, determines its prospective borrowing and faces the repayment problem again in the next period. Upon default, the sovereign receives the output penalty, is excluded from

[23] The sovereign does not have the possibility of defaulting only on the multilateral debt. This is consistent with the fact that, in the empirical analysis, default episodes always involve private creditors.

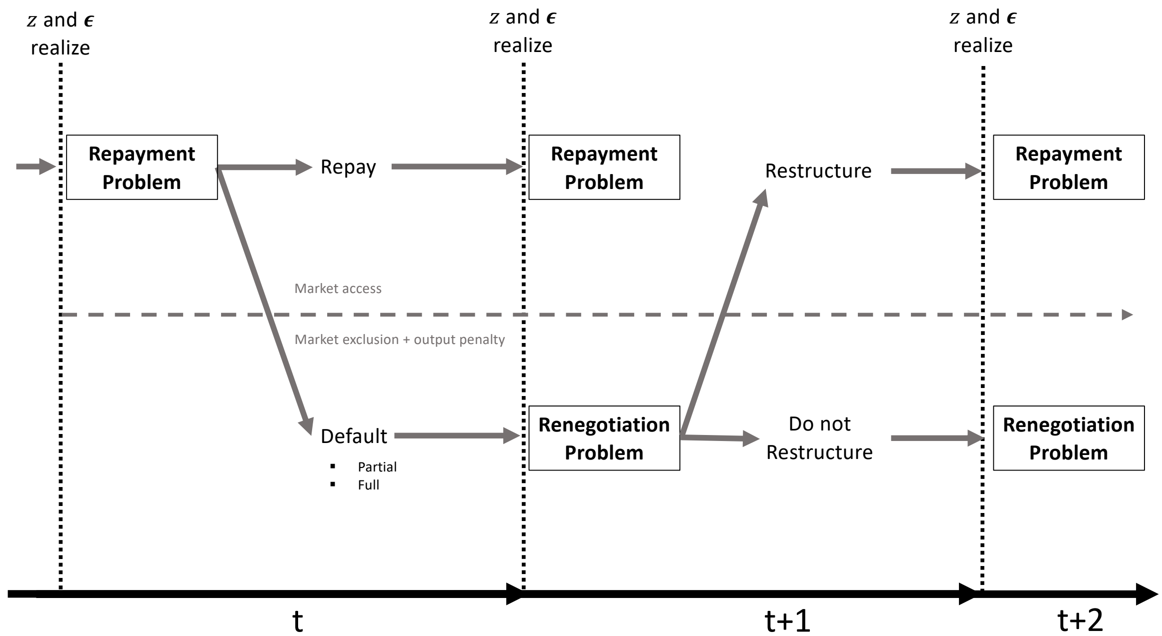



Figure 2: Timing and Problems

the bond market and faces the renegotiation problem in the next period. In this problem, it has to directly bargain with the lenders to restructure its debt. The creditors and the sovereign propose stochastically over multiple rounds. If the negotiating parties agree on a restructuring, the sovereign regains access to the market and faces the repayment problem in the next period. Otherwise, the sovereign remains in autarky and the renegotiation problem repeats next period.

# 6 The Repayment Problem

This section develops the repayment problem. Given the prices, the outcome of the renegotiation problem, the realisation of $(z, \boldsymbol{\epsilon})$ and the current stock of debt, the sovereign decides whether to repay. When defaulting, the sovereign can choose to enter into *partial* or *full* default. The overall beginning of the period value function is then given by

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

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

In the case in which the sovereign decides to honor the terms of all its debt contracts, the Bellman equation reads

$$
\begin{aligned}
V^P(z, \boldsymbol{\epsilon}, b^i_m, b^i_p) = & \max_{j \in \{1,2,\ldots,\mathcal{J}\}} \left\{ u(c) + \epsilon_j + \beta \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} V(z', \boldsymbol{\epsilon}', b^j_m, b^j_p) \right\} \\
\text{s.t.} \quad & c + q_m(z, b^j_m, b^j_p)(b^j_m - \delta b^i_m) + q_p(z, b^j_m, b^j_p)(b^j_p - \delta b^i_p) \\
& = y(z) + [1 - \delta + \delta\kappa]\,(b^i_m + b^i_p).
\end{aligned} \tag{2}
$$

If the sovereign decides to enter into *partial* default, it receives an output penalty and is excluded from the bond market. Moreover, it continues to service the multilateral debt. The Bellman equation for the case of *partial* default is given by

$$
\begin{aligned}
V^{DP}(z, \epsilon_{\mathcal{J}+1}, b^i_m, b^i_p) = & \; u(c) + \epsilon_{\mathcal{J}+1} + \beta \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} V^{RP}(z', \boldsymbol{\epsilon}', b^j_m, b^i_p) \\
\text{s.t.} \quad & c = y^{DP}(z) + [1 - \delta + \delta\kappa]\, b^i_m, \\
& b^j_m = \delta b^i_m.
\end{aligned} \tag{3}
$$

The continuation value $V^{RP}(\cdot)$ is the expected payoff from the renegotiation process with the private creditors and is specified in the next section. Consistent with the policy of non-toleration of arrears, there is no multilateral lending, while the sovereign continues to service its multilateral debt which decays at the rate $\delta$.[24] Hence, the larger is $-b^i_m$, the less attractive is this type of default. Moreover, in the case of one-period debt (i.e. $\delta = 0$), the debt is repaid in one instalment. This further renders the *partial* default unappealing. In opposition, the longer is the average maturity (i.e. $\delta \to 1$), the lower is the debt service incurred every period.

Finally, the Bellman equation in the case of *full* default reads as follows

$$
\begin{aligned}
V^{DF}(z, \epsilon_{\mathcal{J}+2}, b^i_m, b^i_p) = & \; u(c) + \epsilon_{\mathcal{J}+2} + \beta \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} V^{RF}(z', \boldsymbol{\epsilon}', b^i_m, b^i_p) \\
\text{s.t.} \quad & c = y^{DF}(z).
\end{aligned} \tag{4}
$$

The continuation value $V^{RF}(\cdot)$ is the expected payoff derived from the debt renegotiation process with the two creditors. Unlike a *partial* default, the sovereign does not need to service any debt while being in autarky. It is therefore crucial that $y^{DF} < y^{DP}$. I show in Section 10, that when $y^{DP} = y^{DF}$, a *partial* default becomes almost completely unattractive.

[24] The absence of multilateral lending is for tractability. There are occurrence in the data in which multilateral lenders continue to lend when the sovereign is in arrears with respect to the private creditors. In light of this, my model adopts a stringent interpretation of the policy of non-toleration of arrears.

# 7 The Renegotiation Problem

The previous section developed the repayment problem taking as given the outcome of the renegotiation problem. This section does the opposite. To endogenize the renegotiation process, I mainly draw from the framework developed by Bi (2008) and Benjamin and Wright (2013) as it is capable of generating endogenous delays and haircuts. The exact form of the renegotiation process follows Dvorkin et al. (2021).

## 7.1 Partial default

The renegotiation is a multi-round non-cooperative game in which the private lenders and the sovereign propose stochastically. Figure 3 depicts the sequence of actions in the renegotiation with the sovereign's payoffs.

With probability $\phi$ the private lenders have the opportunity to propose and if so the sovereign decides whether to accept. Conversely, with probability $1-\phi$, the sovereign can propose and if so the private lenders decide whether to accept. The probability $\phi$ directly reflects the private lenders' bargaining power as it represents the probability of having the first-mover advantage (Merlo and Wilson, 1995).

An offer states the value of the restructured private debt, $W$. If the proposer does not propose or the recipient does not accept the offer, the renegotiation is delayed, the sovereign stays in autarky and the game repeats next period. Otherwise, the negotiating parties settle, the game ends and the sovereign can return to the repayment problem. Formally,

$$V^{RP}(z,\boldsymbol{\epsilon},b_m^i,b_p^i)=\phi\Omega^{RP}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,W_l^{RP})+(1-\phi)\Omega^{RP}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,W_b^{RP}). \tag{5}$$

$\Omega^{RP}(\cdot)$ is the value derived from a specific offer and $W_l^{RP}$ and $W_b^{RP}$ represent the offer made by the private lenders and the sovereign, respectively.

In each round, the sovereign compares the value of remaining in autarky with the value of paying $W$ and re-accessing the market. Hence, one has that

$$\Omega^{RP}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,W)=\max\left\{V^{DP}(z,\epsilon_{\mathcal{J}+1},b_m^i,b_p^i),V^{EP}(z,\boldsymbol{\epsilon},b_m^i,W)\right\}, \tag{6}$$

where $V^{DP}(\cdot)$ is the value of remaining in autarky and $V^{EP}(\cdot,W)$ is the value of exiting the negotiation with a restructured private debt of value $W$. This defines a stopping function $A^{RP}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,W)$ which takes value one if the restructuring is preferred and zero otherwise.

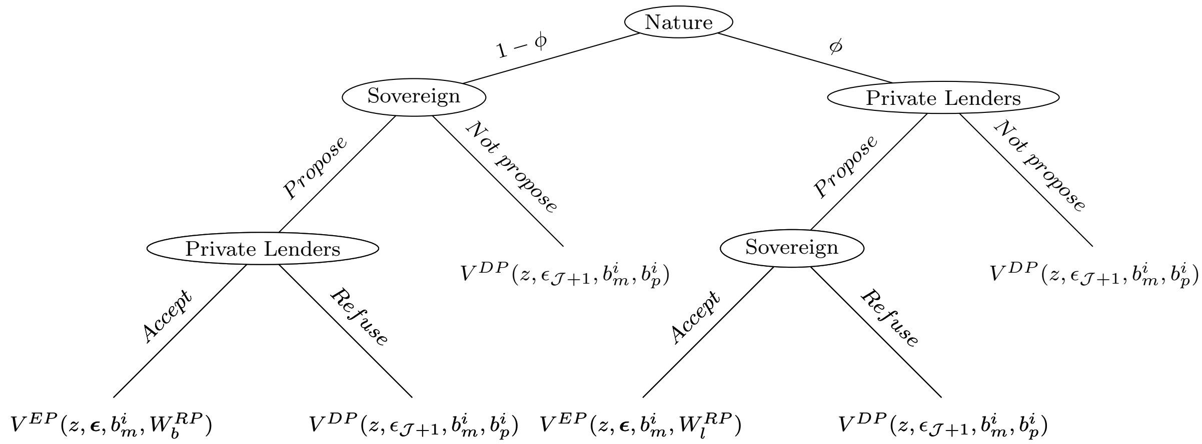



Figure 3: Renegotiation Game Tree in Partial Default

The value upon restructuring is given by

$$
\begin{aligned}
V^{EP}(z,\boldsymbol{\epsilon},b_m^i,W) = \max_{j} \ & \left\{u(c)+\epsilon_j+\beta\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}V(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\right\} \\
\text{s.t.} \quad & c = y(z)+\tau+[1-\delta+\delta\kappa]b_m^i, \\
& \tau = q_p(z,b_m^j,b_p^j)(-b_p^j)-W, \\
& \tau \geq 0, \\
& b_m^j = \delta b_m^i.
\end{aligned} \tag{7}
$$

During the restructuring, the sovereign repays the value of the restructured debt, $W$, 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. $\tau \geq 0$). Due to the policy of non-toleration of arrears, the sovereign can issue new multilateral debt only after clearing private arrears.

The haircut corresponds to $1-\frac{W}{-b_p^i\bar{q}}$. The numerator in the fraction corresponds to the present value of restructured debt, whereas the denominator is the present value of the defaulted debt.

Let's now determine $W_b^{RP}$. Given the risk neutrality of the private lenders, the sovereign cannot offer less than the current market value of defaulted debt if it wants to settle. There is also no reason to offer more. Thus,

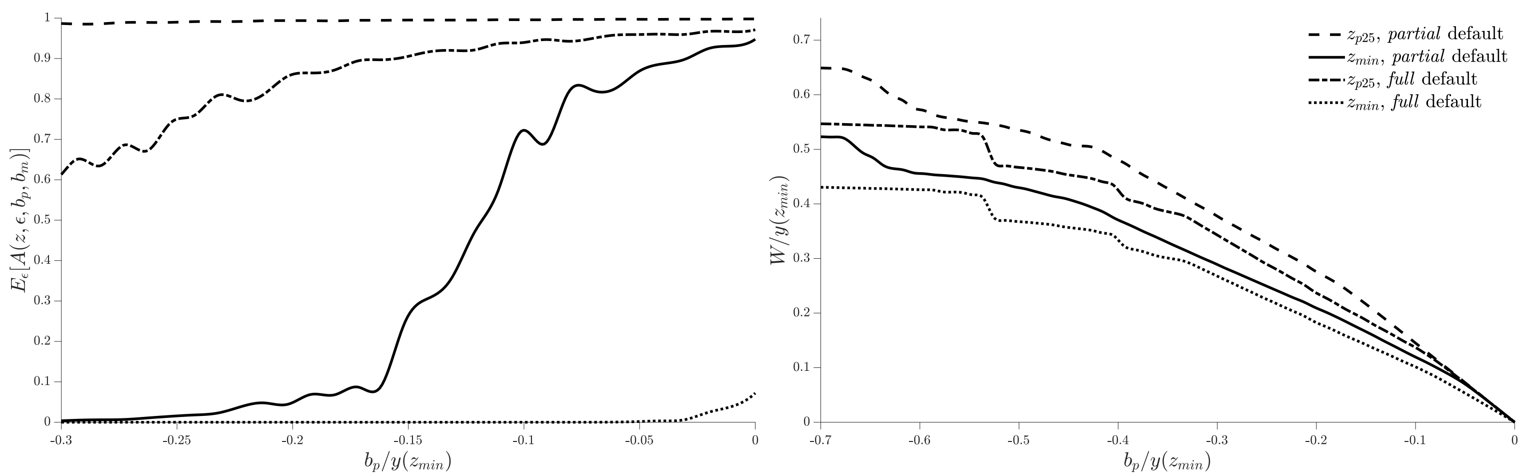
$$
W_b^{RP}(z,b_m^i,b_p^i) = -b_p^i q_p^{DP}(z,b_m^i,b_p^i),
$$

where $q_p^{DP}(\cdot)$ is specified in the next section. The sovereign's offer corresponds the private lenders' reservation value. The private lenders will therefore always accept the sovereign's offer. Nevertheless, the sovereign might decide not to propose (i.e. $A^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W) = 0$) if it is better off staying in autarky.

When the private lenders propose, they consider two main aspects. On the one hand, they should come up with a settlement that the sovereign is likely to accept. On the other hand, they have to make sure to maximize the recovery value. The private lenders' offer is therefore the result of

$$\begin{aligned} W_l^{RP}(z, b_m^i, b_p^i) &= \arg\max \left[\mathbb{E}_{\boldsymbol{\epsilon}} A^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W)W + (1 - \mathbb{E}_{\boldsymbol{\epsilon}} A^{RP}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W))W_b^{RP}(z, b_m^i, b_p^i)\right] \\ &\text{s.t.} \quad W \leq -b_p^i \bar{q}. \end{aligned}$$

In words, the private lenders seek to maximize the recovery value the sovereign is willing to accept under the constraint that the proposed restructuring does not exceed the present value of the defaulted debt.




(a) $\mathbb{E}_\epsilon[A(z, \epsilon, b_p, b_m)]$ (b) $W/y_{min}$

*Note*: Figure 4a depicts the sovereign's acceptance probability and Figure 4b the optimal offer from the private lenders in *partial* and *full* defaults as a function of $b_p$ fixing $(z, b_m)$. The different lines correspond to different levels of endowment and $b_m$ is set to the largest level of debt in the grid. $z_{pX}$ corresponds to the $X^{th}$ percentile of the endowment.

Figure 4: Acceptance Probability and Private Lender's Offer

Figure 4a depicts the sovereign's acceptance probability and Figure 4b the private lenders' offer. As one can see, $W$ decreases in the level of private debt and in the level of endowment. Regarding the acceptance probability, delays are more likely in low endowment states and with larger levels of debt.

What is the source of delays in this set-up? The sovereign usually defaults in low endowment states with a relatively high level of debt. If the sovereign desires to settle at the lowest cost, the least it could pay is $W_b^{RP} = -q_p^{DP}(z, b_m^i, b_p^i)b_p^i$. To get out of default, it would need to issue new private debt. The problem is that in low endowment states, $q_p(z, b_m^i, b_p^i)$

is very close to $q_p^{DP}(z, b_m^i, b_p^i)$ due to the persistence of the shocks. Owing to the constraint $\tau \geq 0$, the sovereign should accumulate a prospective level of debt similar to the one it just defaulted on if it wants to settle. As a result, it runs the risk of falling into default once again next period lowering $V^{EP}(\cdot)$. It is then optimal for the sovereign to wait that the endowment state improves and $q_p(z, b_m^i, b_p^i)$ recovers in order to settle its debt. Note that it is also optimal for the private lenders to wait. When the default risk is high, the recovery value of debt is very low. However, as the default risk diminishes, the private lenders can recover more from the sovereign.

As in Benjamin and Wright (2013), delays therefore originate from the limited enforcement in repayment. In other words, delays in the renegotiation emanate from the same force that generates the default itself.

## 7.2 Full default

To simplify the renegotiation under *full* default, I assume that there are neither coordination nor cooperation problems between the private and the multilateral lenders. The former acknowledge the full repayment of the latter. Hence, the two types of lender jointly propose a common offer with probability $\phi$.[25] The value under renegotiation is given by

$$V^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = \phi\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_l^{RF} - b_m^i\bar{q}) + (1-\phi)\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W_b^{RF} - b_m^i\bar{q}).$$

where $W_b^{RF}$ and $W_l^{RF}$ represent the offer for the private debt made by the sovereign and the two types of lenders, respectively. Consistent with the policy of non-toleration of arrears, irrespective of the proposer, the multilateral debt is always repaid in full – i.e. $-b_m^i\bar{q}$.[26] Nevertheless, the multilateral lender forgoes the missed coupon payments. In other words, there is no accumulation of arrears.

Following the same logic as before, the stopping function $A^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W - b_m^i\bar{q})$ is the result of

$$\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, W - b_m^i\bar{q}) = \max\left\{V^{DF}(z, \epsilon_{\mathcal{J}+2}, b_m^i, b_p^i), V^{EF}(z, \boldsymbol{\epsilon}, b_m^i, W - b_m^i\bar{q})\right\}. \quad (8)$$

where $V^{DF}(\cdot)$ is the value of remaining in full default and $V^{EF}(\cdot, W - b_m^i\bar{q})$ is the value of exiting the renegotiation with a restructured private debt of value $W$ and multilateral debt

[25] It is similar to assume that the sovereign renegotiates with each lender separately but the multilateral lender has a bargaining power of 1.

[26] Note that it is enough to keep track of $W$ instead of $W - b_m^i\bar{q}$ in the state space. However, this makes the dependence on the full repayment of multilateral debt clear.

of value $-b_m^i\bar{q}$. The value under restructuring is given by

$$V^{EF}(z,\boldsymbol{\epsilon},b_m^i,W-b_m^i\bar{q}) = \max_j \left\{u(c)+\epsilon_j+\beta\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}V(z',\boldsymbol{\epsilon}',b_m^j,b_p^j)\right\} \tag{9}$$

$$\begin{aligned} \text{s.t.} \quad & c = y(z)+\tau, \\ & \tau = q_p(z,b_m^j,b_p^j)(-b_p^j)-(W-b_m^i\bar{q}), \\ & \tau \geq 0, \\ & b_m^j = 0. \end{aligned}$$

Upon restructuring, the sovereign repays the value of the restructured debt, $W-b_m^i\bar{q}$, and gets rid of the output penalty. In addition, due to the policy of non-toleration of arrears, the sovereign cannot access multilateral funds as it is clearing its arrears in the current period. The sovereign's offer for the private debt is given by

$$W_b^{RF}(z,b_m^i,b_p^i) = -b_p^i q_p^{DF}(z,b_m^i,b_p^i).$$

Conversely, the lenders' offer for the private debt is the result of

$$\begin{aligned} W_l^{RF}(z,b_m^i,b_p^i) = \arg\max \Big[ & \mathbb{E}_{\boldsymbol{\epsilon}} A^{RF}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,W-b_m^i\bar{q})W \\ & + (1-\mathbb{E}_{\boldsymbol{\epsilon}} A^{RF}(z,\boldsymbol{\epsilon},b_m^i,b_p^i,W-b_m^i\bar{q}))W_b^{RF}(z,b_m^i,b_p^i)\Big] \\ \text{s.t.} \quad W \leq -b_p^i\bar{q}. & \end{aligned}$$

The full repayment of multilateral lenders affects the stopping function $A^{RF}(\cdot,W-b_m^i\bar{q})$. The level of multilateral debt therefore directly impacts $W_l^{RF}$.

How is this setting supposed to generate additional delay? If the multilateral lender was not requesting full repayment, the sovereign could offer $q_m^{DF}(z,b_m^i,b_p^i)(-b_m^i)$ with $q_m^{DF}(z,b_m^i,b_p^i) \leq \bar{q}$ instead of $\bar{q}(-b_m^i)$. In words, the complete repayment of the multilateral debt renders the debt restructuring more costly which depreses the value of restructuring. In addition, compared to a *partial* default, the value of staying in default may be larger in a *full* default as the sovereign does not need to service the multilateral debt in autarky. Hence, the sovereign prefers to stay in default for a longer period of time. Figure 4a depicts the acceptance probability in *partial* and *full* defaults. A successful restructuring is always less likely in *full* defaults for a given state.

Given additional delays, the absence of multilateral debt issuance is necessary to generate haircuts in line with Fact III. In this bargaining game, the haircut is shaped by two opposing forces as shown in Figure 4b. On the one hand, for a given level of endowment, the larger is the level of debt, the larger is the haircut. On the other hand, for a given level of debt, the higher is the endowment, the lower is the haircut due to the lower default risk. As mentioned above, in the case of a *full* default, delays in the renegotiation process are more pronounced which mechanically lead to lower haircuts. The restriction on multilateral debt issuance is thus necessary to counterbalance this effect. As one can see in Figure 4b, for a given state, the private lenders' offer in *full* default is always strictly lower than in *partial* default.

# 8 Prices and Seniority Structure

The previous two sections exposed the repayment problem and, subsequently, the renegotiation problem the sovereign faces. The present section aims at defining the prices and characterising the optimal seniority structure.

## 8.1 Bond prices

Define $D^{DP}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ as the *partial* default policy which takes value one in case of such default and zero otherwise. Similarly, define $D^{DF}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ as the *full* default policy. Regarding borrowing, $b_p(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ and $b_m(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ correspond to the private and multilateral bond policies, respectively.

Private lenders are competitive meaning that in expectations they make zero profit. The price of one unit of bond can therefore be separated into two parts: the return when the sovereign decides to repay and the recovery value when the sovereign defaults.

$$\begin{aligned} q_p(z, b^j_m, b^j_p) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\Big[&\big(1 - D^{DP}(z', \boldsymbol{\epsilon}', b^j_m, b^j_p) - D^{DF}(z', \boldsymbol{\epsilon}', b^j_m, b^j_p)\big)\times \\ &\big(1 - \delta + \delta\kappa + \delta q_p(z', b_m(z', \boldsymbol{\epsilon}', b^j_m, b^j_p), b_p(z', \boldsymbol{\epsilon}', b^j_m, b^j_p))\big)+ \\ &D^{DP}(z', \boldsymbol{\epsilon}', b^j_m, b^j_p) q^{DP}_p(z', b^j_m, b^j_p)+ \\ &D^{DF}(z', \boldsymbol{\epsilon}', b^j_m, b^j_p) q^{DF}_p(z', b^j_m, b^j_p)\Big]. \end{aligned} \tag{10}$$

If the sovereign 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, $\delta q'_p$. If the sovereign decides to renege the debt contract, the private lenders receive the recovery value which depends on the acceptance probability, the bargaining power and the proposed offer. In the case of *partial* default,

$$q^{DP}_p(z, b^i_m, b^i_p) = \frac{1}{1+r}\mathbb{E}_{z'|z}\mathbb{E}_{\boldsymbol{\epsilon}'}\big[(1 - \phi A^{RP}(z', \boldsymbol{\epsilon}', \delta b^i_m, b^i_p, W^{RP}_l)) q^{DP}_p(z', \delta b^i_m, b^i_p)+$$

$$\phi A^{RP}(z', \boldsymbol{\epsilon}', \delta b_m^i, b_p^i, W_l^{RP}) \frac{W_l^{RP}(z', \delta b_m^i, b_p^i)}{-b_p^i}\big].$$

The price is again shaped by the break-even condition. If the private lenders propose and the sovereign accepts the deal, then the recovery value per unit of bond is $\frac{1}{-b_p^i} W_l^{RP}(z', \delta b_m^i, b_p^i)$. Conversely, if the sovereign proposes, the private lenders receive their outside option, $q_p^{DP}(z', \delta b_m^i, b_p^i)$. Finally, if the sovereign refuses to settle or does not propose, it does not disburse anything now, but in present value it pays $q_p^{DP}(z', \delta b_m^i, b_p^i)$. Similarly, in the case of *full* default,

$$q_p^{DF}(z, b_m^i, b_p^i) = \frac{1}{1+r} \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} \big[(1 - \phi A^{RF}(z', \boldsymbol{\epsilon}', b_m^i, b_p^i, W_l^{RF})) q_p^{DF}(z', b_m^i, b_p^i) +$$
$$\phi A^{RF}(z', \boldsymbol{\epsilon}', b_m^i, b_p^i, W_l^{RF}) \frac{W_l^{RF}(z', b_m^i, b_p^i)}{-b_p^i}\big].$$

I can now pass to the price of multilateral debt. Given the risk neutrality and the break-even assumption, the price formula is similar to the one of private debt,

$$q_m(z, b_m^j, b_p^j) = \frac{1}{1+r} \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} \Big[\big(1 - D^{DF}(z', \boldsymbol{\epsilon}', b_m^j, b_p^j)\big) \times \tag{11}$$
$$\big(1 - \delta + \delta\kappa + \delta q_m(z', b_m(z', \boldsymbol{\epsilon}', b_m^j, b_p^j), b_p(z', \boldsymbol{\epsilon}', b_m^j, b_p^j))\big) +$$
$$D^{DF}(z', \boldsymbol{\epsilon}', b_m^j, b_p^j) q_m^{DF}(z', b_m^j, b_p^j)\Big].$$

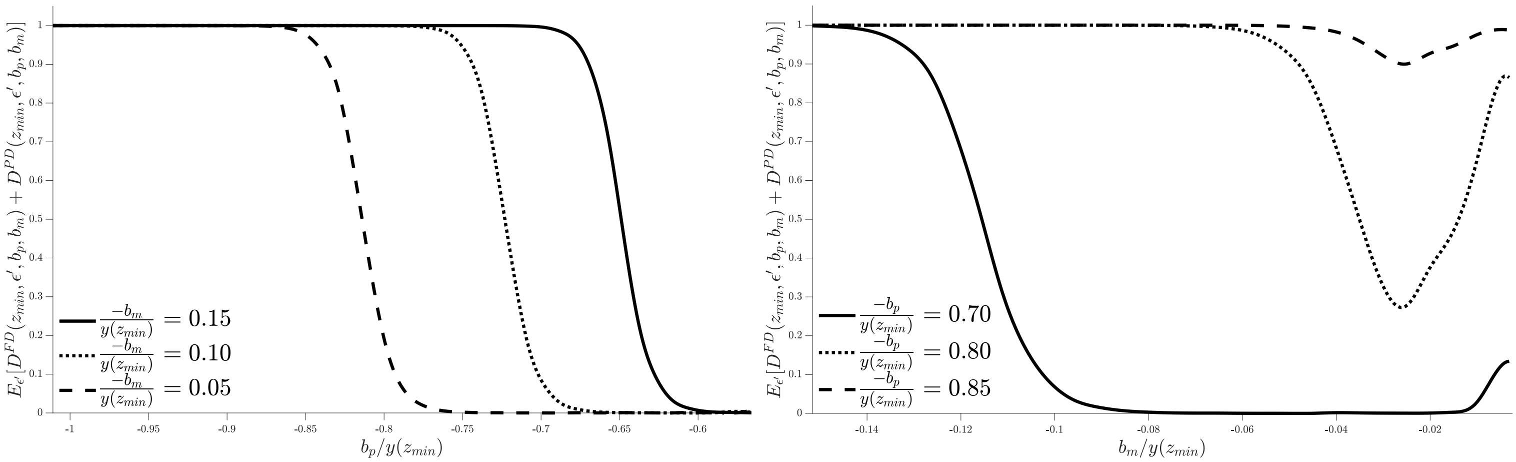
As the multilateral lender is always repaid in full, the recovery value upon *full* default is

$$q_m^{DF}(z, b_m^i, b_p^i) = \frac{1}{1+r} \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} \big[(1 - A^{RF}(z', \boldsymbol{\epsilon}', b_m^i, b_p^i, W_l^{RF})) q_m^{DF}(z', b_m^i, b_p^i) +$$
$$A^{RF}(z', \boldsymbol{\epsilon}', b_m^i, b_p^i, W_l^{RF}) \bar{q}\big].$$

The potential wedge between $q_m^{DF}$ and $\bar{q}$ is solely due to the fact that the multilateral lender forgoes the missed coupon payments. Thus, unlike in Cordella and Powell (2021), the multilateral lender does not necessarily lend at the risk-free rate.

In what follows, I highlight three main features of the bond prices. First, the multilateral debt price is higher than the private bond price and that for two reasons. On the one hand, the default probability on the multilateral debt is lower than on the private debt owing to the greater output penalty. On the other hand, the recovery value for the multilateral debt is higher than the recovery value of private debt due to the policy of non-toleration of arrears.

Second, with monotonic bond policy functions, the private (multilateral) debt price decreases in the amount of private (multilateral) debt. This follows the standard argument of Chatterjee and Eyigungor (2012).



(a) $b_p$ (b) $b_m$

*Note*: The figure depicts the overall default probability as a function of the debt level. Figure 5a plots the overall default probability as a function of $b_p$ where I fix $z$ at $z_{min}$ and $b_m$ at respectively 15%, 10% and 5% of output. Figure 5b plots the overall default probability as a function of $b_m$ where I fix $z$ at $z_{min}$ and $b_p$ at respectively 70%, 80% and 85% of output.

Figure 5: Overall Default Probability

Third, the effect of the multilateral debt on the private debt price is ambiguous. The reason is that the multilateral debt has two opposite effects on the default risk. On the one hand, more multilateral debt reduces the probability of a *partial* default given the additional multilateral debt servicing costs in autarky. On the other hand, more multilateral debt increases the probability of a *full* default. Thus, if additional multilateral debt decreases the probability of a *partial* default without a one-to-one increase in the probability of *full* default, the overall default risk effectively decreases.[27] Figure 5b depicts the default probability as a function of $b_m$ and shows it is indeed U-shaped in some states. In opposition, Figure 5a depicts the same statistic as a function of $b_p$ and shows no such pattern.

In particular, the effect of the multilateral debt on the private bond price depends on the interaction between the default and the subordination risks. The multilateral debt increases the subordination risk of private debt. As seen in Figure 4b, in a *full* default, absolute priority is given to the repayment of the multilateral debt and the private lenders receive what is left. Hence, if additional multilateral debt increases the default probability, then the private bond price unambiguously decreases in the amount of multilateral debt as the default and the subordination risks go in the same direction. In opposition, if additional multilateral debt decreases the default probability, the private debt price may not necessarily decrease. The reduction in the default probability might be sufficiently large to compensate the reduction in the recovery value of private debt and potential future dilutions. Figure 5b suggests that this can only happen when the level of multilateral debt is not too large.

[27]This is possible given that $y \geq y^{DP} > y^{DF}$.

## 8.2 Optimal seniority structure

Having determined the prices, I can now characterize the optimal seniority structure. The definition of the competitive equilibrium can be found in Appendix D.

To understand the tradeoff involved in the borrowing decision, I analyze the optimality conditions for the sovereign. I adopt a heuristic approach relying on three main assumptions. First, the bond choices have a continuous and compact support $B_p = [b_p^1, b_p^{\mathcal{P}}]$ and $B_m = [b_m^1, b_m^{\mathcal{M}}]$ without utility shocks. Second, I disregard buybacks and consider the case in which $b_j' - \delta b_j < 0$ for all $j \in \{m, p\}$. Third, as Arellano and Ramanarayanan (2012) and Arellano et al. (2023), I assume that the bond price functions $q_m(\cdot)$ and $q_p(\cdot)$ and the value of repayment $V^P(\cdot)$ are differentiable everywhere.[28] I then derive the first-order necessary conditions of the sovereign's problem given in (2) with respect to $b_m'$,

$$u_c(c)\left[\frac{\partial q_m}{\partial b_m'}(b_m' - \delta b_m) + q_m + \frac{\partial q_p}{\partial b_m'}(b_p' - \delta b_p)\right] = \beta \mathbb{E}^R_{z'|z}\left[u_c(c')(1 - \delta + \delta\kappa + \delta q_m')\right], \tag{12}$$

and with respect to $b_p'$,

$$u_c(c)\left[\frac{\partial q_m}{\partial b_p'}(b_m' - \delta b_m) + \frac{\partial q_p}{\partial b_p'}(b_p' - \delta b_p) + q_p\right] = \beta \mathbb{E}^R_{z'|z}\left[u_c(c')(1 - \delta + \delta\kappa + \delta q_p')\right], \tag{13}$$

where $\mathbb{E}^R$ is the expectation in repayment, $u_c(\cdot)$ represents the first derivative of $u(\cdot)$ with respect to $c$ and $q_j' = q_j(z', b_m'', b_p'')$ for $j \in \{m, p\}$ is the bond price next period. The left-hand side of each first-order condition represents the marginal benefits of issuing one additional unit of the type of debt concerned, whereas the right-hand side represents the marginal costs of this additional issuance. Following the argument in the previous subsection, one has

$$\frac{q_m}{q_p} \geq 1, \quad \frac{\partial q_p}{\partial b_p'} \geq 0, \quad \frac{\partial q_m}{\partial b_m'} \geq 0 \quad \text{and} \quad \frac{\partial q_p}{\partial b_p'} \lesseqgtr \frac{\partial q_p}{\partial b_m'}.$$

This together with the first-order conditions unveil two effects that shape the optimal holdings of debt in the model: the seniority benefit or cost and the subordination benefit. The former relates to the multilateral debt and is given by the ratio of the left-hand side of (12) and (13) each divided by the private debt price,

$$\text{Seniority benefit or cost} = \frac{\frac{q_m}{q_p} + \frac{\partial q_m}{\partial b_m'}\frac{(b_m' - \delta b_m)}{q_p} + \frac{\partial q_p}{\partial b_m'}\frac{(b_p' - \delta b_p)}{q_p}}{1 + \frac{\partial q_m}{\partial b_p'}\frac{(b_m' - \delta b_m)}{q_p} + \frac{\partial q_p}{\partial b_p'}\frac{(b_p' - \delta b_p)}{q_p}}.$$

[28] Mateos-Planas et al. (2022) show that this is generally not the case.

The numerator (denominator) corresponds to the marginal impact of issuing multilateral (private) debt on the incentive to repay. Whether there is a seniority benefit or a seniority cost depends on the relative sensitivity of the private bond price with respect to the two types of debt. Given that the multilateral debt is eventually repaid in full, one would expect that $\frac{\partial q_m}{\partial b'_m} \approx \frac{\partial q_m}{\partial b'_p}$. Thus, if $\frac{\partial q_p}{\partial b'_p} > \frac{\partial q_p}{\partial b'_m}$, the sovereign has a greater incentive to repay when it issues multilateral debt. As argued before, this typically happens when $-b'_m$ is relatively small. In this case there is a seniority benefit to the repayment incentive. Conversely, when $\frac{\partial q_p}{\partial b'_p} < \frac{\partial q_p}{\partial b'_m}$, there are two cases. If $\frac{q_m}{q_p}$ is sufficiently large, there is still a seniority benefit. Otherwise, the sovereign has a lower incentive to repay when it issues multilateral debt and there is therefore a seniority cost.

The subordination benefit relates to the private debt and corresponds to the ratio of the right-hand side of (12) and (13),

$$\text{Subordination benefit} = \frac{\mathbb{E}^R_{z'|z}\left[u_c(c')(1-\delta+\delta\kappa+\delta q'_m)\right]}{\mathbb{E}^R_{z'|z}\left[u_c(c')(1-\delta+\delta\kappa+\delta q'_p)\right]},$$

which one can reformulate as

$$\frac{\mathbb{E}^R_{z'|z}\left[u_c(c')\right]\mathbb{E}^R_{z'|z}\left[1-\delta+\delta\kappa+\delta q'_m\right]+\operatorname{cov}(u_c(c'),\delta q'_m)}{\mathbb{E}^R_{z'|z}\left[u_c(c')\right]\mathbb{E}^R_{z'|z}\left[1-\delta+\delta\kappa+\delta q'_p\right]+\operatorname{cov}(u_c(c'),\delta q'_p)}.$$

Owing to the *de facto* seniority, it is difficult to dilute the multilateral debt. The sovereign is less likely to renege multilateral debt and when it does it has to repay in full what it defaulted on. Hence, $q'_m$ remains relatively close to $\bar{q}$ due to the high recovery value, while $q'_p$ can get closer to 0. This means that in low endowment states, the price of private debt tomorrow, $q'_p$, can decrease relatively more when the prospective consumption is low. If this is the case, then the above ratio is greater than one as $\operatorname{cov}(u_c(c'),q'_p) \le \operatorname{cov}(u_c(c'),q'_m) < 0$ and $\mathbb{E}^R_{z'|z}\left[q'_m\right] \ge \mathbb{E}^R_{z'|z}\left[q'_p\right]$. The private debt becomes therefore more attractive to the sovereign than the multilateral debt. The possibility to dilute private debt reduces the marginal cost of debt issuance as it reduces the future debt burden.

All in all, the multilateral debt has a dual effect. In small amount, it can generate a large value at the issuance, whereas, in large amount, it overly depresses the value of private debt issuance owing to subordination. In addition, it is less prone to dilution than private debt making it more costly to repay at the maturity. This shapes the borrowing choice of the sovereign. In particular, the optimal seniority structure is determined such that the seniority benefit or cost equates the subordination benefit.[29]

[29]Note that with one-period debt (i.e. $\delta = 0$), there is no subordination benefit. In this case, the

This tradeoff closely relates to the one in Arellano and Ramanarayanan (2012) and Niepelt (2014) in which the sovereign has to choose between short-term and long-term debts. The former debt has to be repaid in the next period, while only a fraction of the latter 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, whereas the long-term debt provides an hedge against future low endowments. In my model, the tradeoff is similar with the main exception that more multilateral debt – unlike short-term debt – does not always increase the incentive to repay.

The spillover effect of multilateral debt on private debt addresses the catalytic function of official multilateral lending. As noted by Krahnke (2020), the seniority can crowd out private capital flows if the amount of senior debt becomes too large. A similar effect arises in this model. While some level of multilateral debt encourages the sovereign to repay its debt, large amounts of multilateral debt considerably dilute the private debt.

# 9 Calibration and Model Evaluation

This section presents the calibration of the model and evaluates the goodness of fit with respect to targeted moments, the empirical facts of Section 4 and other non-targeted moments.

## 9.1 Calibration and targeted moments

The model is solved using numerical methods presented in Appendix E 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 for the period 1970 to 2018 with a yearly frequency. Table 2 summarizes the main parameters of the model. The utility function takes the constant relative risk aversion (CRRA) form,

$$u(c) = \frac{c^{1-\varrho}}{1-\varrho},$$

where the risk aversion parameter, $\varrho$, is set to the standard value of 2 adopted in the real business cycle literature. The risk-free rate is 4.2% to match the average real 10-year US Treasury bonds yield (Dvorkin et al., 2021).[30] Finally, the stochastic process follows a log-normal AR(1) process $\log y_t = \rho \log y_{t-1} + \varepsilon_t$ with $\varepsilon \sim N(0, \sigma_\varepsilon^2)$. Following the estimation

sovereign issues private and multilateral debt such that the seniority benefit or cost equates the ratio of expected marginal utilities in repayment.

[30] Average 10-year US Treasury bond rate minus PCE inflation between 1980 and 2010.

of Aguiar and Gopinath (2006) for Argentina, the persistence of the endowment shock $\rho$ is set to 0.9 and the standard deviation $\sigma_\varepsilon$ to 0.034. The stochastic process is discretized into a 8-state Markov chain following the approach of Tauchen (1986).

Table 2: Parameters

| Parameter | Value | Description | Targeted Moment | Target | Model |
|---|---|---|---|---|---|
| A. Based on Literature | | | | | |
| $\varrho$ | 2 | Risk aversion | | | |
| B. Direct Measure from the Data | | | | | |
| $r$ | 0.042 | Risk-free rate | Average 10-year US real Treasury yield | | |
| $\delta$ | 0.9 | Reciprocal of average maturity | Average maturity structure | | |
| $\kappa$ | 0.12 | Coupon payments | Average coupon rate | | |
| $\rho$ | 0.9 | Output persistence | Argentina GDP | | |
| $\sigma_\epsilon$ | 0.034 | Standard deviation | | | |
| C. Based on Model solution | | | | | |
| $\beta$ | 0.9415 | Discount factor | Debt-to-GDP ratio (%) | 41.58 | 40.77 |
| $\mathcal{A}$ | -0.12 | Multilateral borrowing limit | Multilateral-debt-to-GDP ratio (%) | 5.89 | 6.27 |
| $\phi$ | 0.4915 | Bargaining power | Average SZ haircut (%) | 37.50 | 35.46 |
| $\psi$ | 0.882 | General default cost | Average default duration (year) | 3.60 | 3.11 |
| $\varkappa^{DP}$ | 0.89 | Initial *partial* default cost | Default rate (%) | 2.50 | 2.46 |
| $\varkappa^{DF}$ | 0.85465 | Initial *full* default cost | Share *full* default (%) | 17.65 | 18.52 |
| $\alpha_1$ | $10^{-8}$ | Debt issuance cost (intercept) | Average issuance costs (%) | 0.20 | 0.11 |
| $\alpha_2$ | 19.5 | Debt issuance cost (slope) | Debt increase prior to default (percentage point) | 22.00 | 26.84 |
| $\omega$ | 0.0075 | Utility shock variance parameter | Standard deviation debt-to-GDP ratio | 8.00 | 9.84 |
| $\upsilon$ | 0.2 | Utility shock correlation parameter | Standard deviation duration | 4.67 | 3.37 |

Following Chatterjee and Eyigungor (2012), I set $\kappa = 0.12$ to directly match the average coupon rate of Argentina. I choose $\delta = 0.9$ to match the average maturity which I estimate as the ratio of the external debt over the external debt service.[31] I subsequently select the value of the discount factor to match the average external debt-to-GDP ratio of Argentina. I obtain $\beta = 0.9415$ which is within the bounds admitted in the real business cycle and sovereign debt literature. In addition, the bargaining power is set so as to match the overall average SZ haircut. The value of 0.4915 gives a minor advantage to the borrower, whereas Benjamin and Wright (2013) and Dvorkin et al. (2021) set $\phi$ slightly above 0.5 giving a minor advantage to the lenders. Note that the average haircut for defaults with multilateral creditors (i.e. *full* defaults) is not targeted.

I introduce an exogenous limit $\mathcal{A} \leq 0$ to multilateral debt and that for two reasons. First, without this, the sovereign would accumulate mostly multilateral debt and very little private debt. Second, a borrowing limit is consistent with the fact that the IMF and the WB impose lending quotas. I calibrate $\mathcal{A}$ to match the multilateral debt-to-GDP ratio of Argentina.

Similar to Dvorkin et al. (2021), I differentiate the output cost when entering and staying in default. When the sovereign enters a *partial* default, its endowment is given by $y^{DP}(z) = \varkappa^{DP} y^D(z)$, while if it enters a *full* default, it receives $y^{DF}(z) = \varkappa^{DF} y^D(z)$. Conversely, if

[31] Based on Broner et al. (2013), many studies target an average maturity of 5 years for Argentina. My target of 10 years diverges from this benchmark as Broner et al. (2013) estimate the maturity using private bonds, while my estimate takes into account the total external debt.

the sovereign stays in default its endowment is given by $y^{DP}(z) = y^{DF}(z) = y^D(z)$, where

$$y^D(z) = \begin{cases} \bar{y}, & \text{if } y(z) \geq \bar{y} \\ y(z) & \text{if } y(z) < \bar{y} \end{cases} \quad \text{with } \bar{y} = \psi \mathbb{E}[y(z)]$$

The output cost is made of two components: $\psi$ and $(\varkappa^{DF}, \varkappa^{DP})$. The former relates to the standard asymmetric cost of Arellano (2008). It directly impacts the length of default and is therefore not specific to the type of default as I target the overall average default duration. The initial default cost impacts the default rate. Hence, I calibrate $\varkappa^{DP}$ to match a 2.5% default rate (Tomz and Wright, 2007, 2013) and $\varkappa^{DF}$ to match the share of defaults on multilateral debt reported in Fact I.

Owing to the positive recovery value of debt, this model is subject to large increases in indebtedness and consumption booms prior to default. This problem is further reinforced by the fact that additional multilateral debt can largely dilute private debt. There are different ways of dealing with this problem. Hatchondo et al. (2016) impose a limit on the private bond spread, Dvorkin et al. (2021) set a transaction cost on portfolio adjustments and Fourakis (2021) adds a premium related to the default risk. To avoid to distort too much the tradeoff between private and multilateral debt and the choice between *partial* and *full* default, I adopt an issuance cost of the following form

$$\varpi(b_p^j, b_p^j) = \alpha_1 \exp\Big(\alpha_2 |b_p^j + b_m^j|\Big) - \alpha_1.$$

The parameter $\alpha_1$ commands the intercept, while $\alpha_2$ gives the slope of the issuance cost. The former is calibrated to match an issuance cost of 0.2% and the latter to match the increase of the debt ratio prior to default.

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. In Appendix F, I show that with this calibration, the utility shocks do not significantly impact the default rate, the haircuts, the duration or the debt choices.

## 9.2 Facts and other non-targeted moments

In terms of non-targeted moments, I first assess how the model matches the empirical facts of Section 4. As one can see in Table 3, without directly targeting such moments, the model generates haircuts and durations that are in line with Facts II and III and that for defaults with and without multilateral creditors. The model nonetheless underestimates the average length and haircut of defaults implicating multilateral creditors. It can get closer to the median values but cannot exactly match the duration. Finally, the multilateral lender lends at a rate very close to the risk-free rate consistent with Fact IV.

Table 3: Empirical Facts

| | Data | | Model | |
|---|---|---|---|---|
| | Mean | Median | Mean | Median |
| Default length (year) (overall) | 3.60 | 1.58 | 3.11 | 1.69 |
| Default length (year) (with multilateral lenders) | 8.50 | 7.58 | 4.95 | 4.15 |
| Default length (year) (without multilateral lenders) | 2.60 | 1.33 | 2.68 | 1.58 |
| Private creditors' haircut (%) (overall) | 37.50 | 32.50 | 35.46 | 36.08 |
| Private creditors' haircut (%) (with multilateral lenders) | 59.00 | 55.20 | 49.34 | 49.71 |
| Private creditors' haircut (%) (without multilateral lenders) | 32.90 | 29.00 | 32.14 | 34.25 |
| Share *full* default (%) | 17.65 | - | 18.52 | - |
| Multilateral debt spread (%) | 0.54 | 0.89 | 0.44 | 0.26 |

*Note*: Data moments come from Table 1. The multilateral debt spread corresponds to the quarterly average spread removing the concessional lending of the IDA.

I also gauge how the model matches non-targeted business cycles moments presented in Table 4. I find that it replicates moments related to consumption in an accurate way except perhaps for the relative volatility which is below 1. For the trade balance, the model indicates a surplus as in the data. However, it fails to generate countercyclical trade balance. In addition, the model can reproduce neither the mean nor the volatility of the private debt spread. Nevertheless, the maximum private debt spread amounts 31% which is in-between the maximum observed in Argentina and emerging economies. The spread on multilateral debt is 0.44% which is close to the IMF's and the IBRD's spread. Besides this, it is roughly three times smaller than the private spread. The same holds true for the relative volatility which is around 0.40 for the private debt, but only amounts 0.12 for the multilateral debt.

In comparison to previous studies, my model matches relatively well moments related to emerging economies. Dvorkin et al. (2021) report an average spread of 1.01% overall and 1.37% in bad time. They also cannot generate a countercyclical trade balance. Calibrating a model with long-term bonds and exogenous restructuring to Argentina, Chatterjee and

Table 4: Selected Business-Cycle Moments

| $x$ | Mean($x$) | Max($x$) | Min($x$) | Std($x$) | Std($x$)/Std($y$) | Corr($x,y$) |
|---|---|---|---|---|---|---|
| $c$ | | | | | | |
| Model | 98.05 | 120.08 | 86.94 | 0.03 | 0.96 | 0.92 |
| Argentina | 75.27 | 86.08 | 63.79 | 0.04 | 1.17 | 0.98 |
| $(y-c)/y$ | | | | | | |
| Model | 1.95 | 13.06 | -20.08 | 0.01 | 0.39 | 0.29 |
| Argentina | 1.83 | 9.11 | -2.90 | 0.01 | 0.31 | -0.90 |
| $r_p - r$ | | | | | | |
| Model | 1.17 | 31.40 | 0.00 | 0.01 | 0.40 | -0.45 |
| EMBI+ Spread for Emerging Markets | 4.72 | 12.36 | 1.62 | 0.02 | 0.74 | - |
| EMBI+ Spread for Argentina | 13.51 | 57.23 | 3.20 | 0.16 | 4.77 | -0.63 |
| $r_m - r$ | | | | | | |
| Model | 0.44 | 7.89 | 0.00 | 0.00 | 0.12 | -0.51 |
| IMF Spread | 0.76 | 4.13 | -1.76 | 0.01 | 0.43 | -0.21 |
| IBRD Spread | 0.30 | 1.96 | -2.41 | 0.01 | 0.41 | -0.20 |
| IDA Spread | -1.78 | 1.31 | -6.63 | 0.02 | 0.70 | -0.31 |

*Note*: The sample runs from 1970 to 2018. Consumption mean, min and max are with respect to output. Output, consumption and the trade balance are detrended with the Hodrick-Prescott filter with a smoothing parameter of 6.25. The IMF, the IBRD and the IDA spreads correspond respectively to the IMF adjusted rate of charge, the IBRD lending rate and the IDA service charge from which is deducted the yield on 1-year US government bonds. See Appendix B for more details.

Eyigungor (2012) report an average spread of 8.15% with a standard deviation of 0.04.[32] Moreover, they obtain a correlation between consumption and output of 0.99 and a correlation between the trade balance (over output) and output of $-0.44$. Finally, they report a volatility of consumption relative to output of 1.11 and a volatility of the trade balance (over output) relative to output of 0.2. Hence, except for the countercyclical trade balance and the spread moments, my model generates statistics very close the aforementioned ones. Especially, Chatterjee and Eyigungor (2012) obtain a better fit for the spread for two reasons. First, they assume a recovery value of zero, while the present model generates strictly positive recovery values. Second, they use a quadratic default penalty function to match the volatility of spread, while I adopt the standard asymmetric penalty.

# 10 Quantitative Analysis

In this section, I first study the dynamic of default through an event analysis. I then conduct counterfactual analyses regarding the seniority assumption and assess the changes in welfare. In Appendix G, I relax the assumption of equal maturity for the two types of debt.

[32] See Asonuma and Joo (2020) for a comparison of models with endogenous and exogenous restructurings under short-term debt.

## 10.1 Default dynamic

This subsection aims at explaining the dynamic of defaults in the model. For this purpose, I first compute the statistics of endowment and indebtedness close to default episodes. I subsequently conduct an event analysis in a window of five years before and after a default.

Table 5: Endowment and Debt Around Default

| | | Endowment (percent of $\overline{y}$) | Private debt (percent of y) | Multilateral debt (percent of y) | Total debt (percent of y) |
|---|---|---|---|---|---|
| *Partial* default | Before | 87.3 | 39.5 | 7.5 | 47.1 |
| | At | 76.9 | 68.2 | 0.5 | 68.8 |
| | After | 91.4 | 44.5 | 0.4 | 44.9 |
| *Full* default | Before | 90.5 | 59.6 | 8.0 | 67.6 |
| | At | 75.2 | 98.0 | 15.8 | 113.8 |
| | After | 97.1 | 64.2 | 0.0 | 64.2 |

*Note*: The table depicts the average endowment and debt around *partial* and *full* defaults. The 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.

Table 5 depicts the main statistics of the model around defaults. The general dynamic is consistent with the empirical findings of Benjamin and Wright (2013). First, default's settlements usually arise when the sovereign's economic situation recovers. Most notably, defaults tend to start when the sovereign's GDP is below trend, whereas it usually ends when the sovereign's GDP settles back on the trend. Second, default's resolutions are not associated with a substantial reduction of indebtedness.[33] Third, the sovereign does not necessarily accumulate the same level of debt depending on the type of default. Particularly, *partial* defaults are associated with lower levels of debt than *full* defaults.

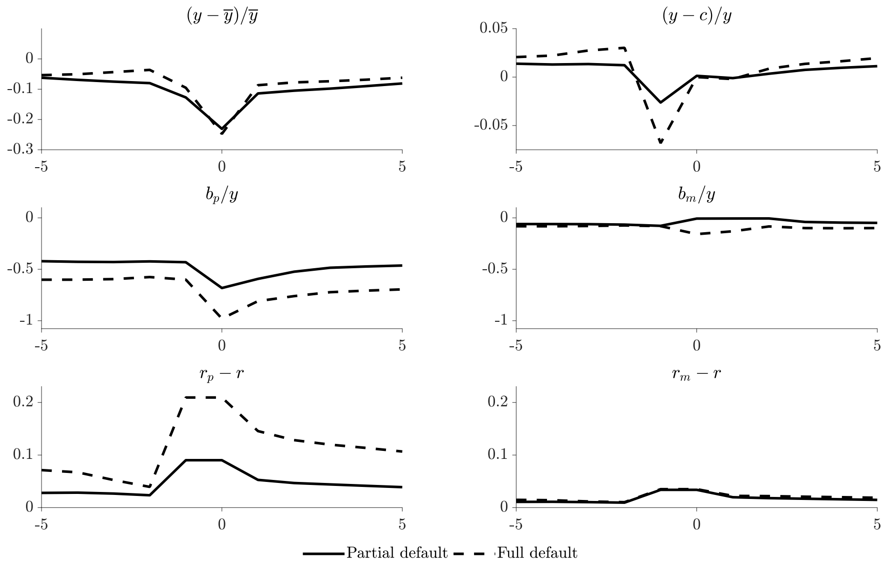
To construct the event analysis, I simulate 2000 economies for 600 periods. To make sure that the initial conditions do not matter, I discard the first 200 periods. I then identify the five periods preceding and succeeding a default and take the average over the simulated panel. I discriminate between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

Figure 6a depicts the event analysis for some selected variables in the model.[34] Period 0 corresponds to the occurrence of default. The solid line relates to a *partial* default, while the dashed line corresponds to a *full* default. As one can clearly see, *full* defaults are precedented by a rapid output contraction and a greater accumulation of debt. Furthermore, the sovereign country records a trade balance reversal at time 0. In the year before a *full* default, the trade balance becomes negative and suddenly reverts with the default. Finally, the private bond

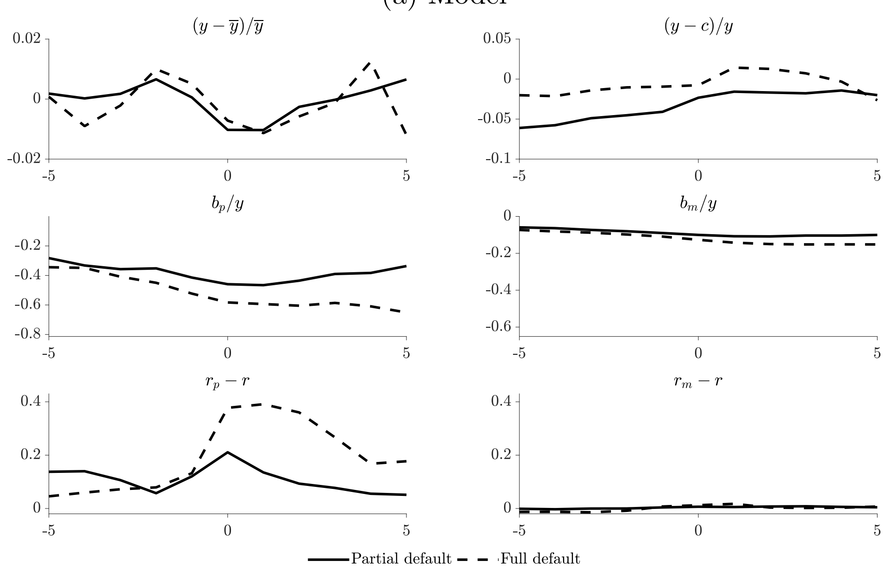
[33]Nevertheless, as noted by Arellano et al. (2023), the model does not generate a larger indebtedness at the end of default compared to the beginning of default.

[34]See Figure A.5 for the median instead of the average over the simulated panel.

spread experiences a sudden and very large increase shortly before the occurrence of default. The multilateral debt spread also reacts but in a negligible manner.




(a) Model




(b) Data

*Note*: The figure depicts the evolution of endowment, trade balance, debt and spreads around *partial* and *full* defaults. Period 0 corresponds to the occurrence of default. In the model, the five-year window 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 entire sample used in Section 4. 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. See Appendix B for more details.

Figure 6: Event Analysis

In opposition, *partial* defaults are related to a slower output contraction. Despite different output costs, the average endowment at time 0 is similar to the one in *full* defaults. Moreover, there is a relatively limited trade balance reversal in the vicinity of default. Besides this, one observes a reduction of multilateral indebtedness on the default path. Most of the indebtedness comes from the private sector. The private bond spread increases as the economy approaches default but far less than in the case of *full* defaults. Consistent with what has been said before, the multilateral debt spread remains relatively modest in comparison to the private debt spread.

Figure 6b depicts the event analysis for some selected variables in the data. As in the model, a *full* default arises after sudden and sharp reduction in output, when the level of indebtedness is large. The average output at time 0 is similar to the one in *full* defaults. In addition, the private debt spread reacts more than in a *partial* default. The trade balance reversal is nonetheless less marked in the data. Thus, except for the trade balance, the models replicates very closely the movements in the data in the vicinity of a default.

## 10.2 Towards a de jure seniority

This subsection analyzes the role of the output penalty. In the calibration, I assumed that the output penalty differs between *partial* and *full* defaults only when entering default. I therefore consider two extreme cases. First, I equalize $\varkappa^{DF}$ and $\varkappa^{DP}$ to show that this mainly affects the share of *full* default. Second, I set $\varkappa^{DF} = 0$ which, given the form of the utility function, implies a *de jure* seniority on multilateral debt.

Table 6 depicts the moments related to the model with different output penalties alongside the benchmark model. In the case of equal output penalty – i.e. $\varkappa^{DF} = \varkappa^{DP} = 0.85465$ – the share of *full* default becomes almost 100%. The default's length and the haircut reduce compared to the benchmark prediction but the wedge between *partial* and *full* defaults remains. As seen in the previous subsection, *full* defaults are associated with larger indebtedness. This explains the greater average debt ratio. Moreover, despite a lower default rate, the private bond spread is larger as the private debt is subordinated in *full* defaults. Finally, even though *full* defaults are more frequent, the multilateral debt spread remains stable.

The model with equal output penalty exaggerates the occurrence of *full* defaults compared to the data but does not significantly affect the wedge in duration and haircut between *partial* and *full* defaults. It therefore shows the role of such channel in generating the *de facto* seniority.

Turning to the case in which $\varkappa^{DF} = 0$, the multilateral debt becomes *de jure* senior. The model is similar to the one of Hatchondo et al. (2017) with the difference that the default's length and the haircut are endogenous. As one can see in Table 6, the default's duration becomes more pronounced, while the average haircut reduces relative to the benchmark case. Furthermore, the default rate, the private bond spread and the debt ratio increase. I come back later on why the default's duration and the total indebtedness increase so much.

Table 6: Alternative Settings

| | Benchmark | $\varkappa^{DF} = \varkappa^{DP}$ | *de jure* | $\mathcal{A} = 0$ | *pro rata* | $b^j_m \leq 0$ | *pari passu* |
|---|---|---|---|---|---|---|---|
| Default length (year) (with multilateral lenders) | 4.95 | 3.51 | - | - | 3.01 | 5.58 | 2.63 |
| Default length (year) (without multilateral lenders) | 2.68 | 1.87 | 5.73 | 5.59 | 2.82 | 5.88 | 2.96 |
| Private creditors' haircut (%) (with multilateral lenders) | 49.34 | 44.52 | - | - | 29.93 | 25.47 | 30.54 |
| Private creditors' haircut (%) (without multilateral lenders) | 32.14 | 37.95 | 21.94 | 22.68 | 28.98 | 24.29 | 29.59 |
| Share *full* default (%) | 18.52 | 97.80 | 0.00 | - | 10.07 | 65.72 | 24.51 |
| Default rate (%) | 2.46 | 2.15 | 3.43 | 3.78 | 2.34 | 3.61 | 2.34 |
| Total debt increase (percentage point) (prior to default) | 26.84 | 39.49 | 25.25 | 23.89 | 20.69 | 30.05 | 21.83 |
| Total debt to GDP (%) | 40.77 | 44.59 | 58.61 | 54.39 | 40.71 | 59.55 | 40.24 |
| Multilateral debt to GDP (%) | 6.27 | 6.62 | 6.46 | - | 6.28 | 6.99 | 6.22 |
| Private debt spread (%) | 1.17 | 1.27 | 1.46 | 1.56 | 0.90 | 1.61 | 0.94 |
| Multilateral debt spread (%) | 0.44 | 0.29 | 0.00 | - | 0.66 | 0.69 | 0.73 |

To complement the above argument, I also consider the case in which the sovereign has only access to private debt – i.e. $\mathcal{A} = 0$. This brings my analysis closer to the one of Benjamin and Wright (2013). As one can see in Table 6, the model without the multilateral lender generates predictions very close to the case of *de jure* seniority in terms of haircut, default length, default rate and spread. However, it produces unrealistic default durations compared to the ones reported in Table 1. Hence, even though multilateral debt represents a small portion of the total debt and *full* defaults are infrequent, the presence of multilateral debt directly affects the average haircut and duration. The coexistence of multilateral and private debt seems therefore a key element explaining the dynamic of emerging economies.

## 10.3 Towards a pari-passu clause

I introduce a *pari passu* clause between the multilateral and the private lender which consists of two components. On the one hand, there is the possibility of a net multilateral debt issuance (i.e. $b^j_m \leq 0$) upon restructuring. On the other hand, the multilateral and private lenders make a common offer $W$ which is split *pro rata*. That is the multilateral lender is not anymore repaid in full. To identify the impact of each of these two components, I consider them separately before joining them together.

To analyze the *pro rata* split, consider that the two types of lenders make a joint offer $X$ for the entire debt. Formally, the value of a restructuring upon *full* default reads

$$V^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i) = \phi \Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, X_l^{RF}) + (1-\phi)\Omega^{RF}(z, \boldsymbol{\epsilon}, b_m^i, b_p^i, X_b^{RF}).$$

where the sovereign's offer is given by

$$X_b^{RF}(z, b_m^i, b_p^i) = -b_p^i q_p^{DF}(z, b_m^i, b_p^i) - b_m^i q_m^{DF}(z, b_m^i, b_p^i).$$

Conversely, the joint offer of the private and multilateral lender is

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

Finally, the transfer upon restructuring is given by

$$\tau = q_m(z, b_m^j, b_p^j)(-b_m^j) - X \geq 0,$$

where the private lenders get a share $\frac{b_p^j}{b_p^j + b_m^j}$ of $X$ upon restructuring and the multilateral lender the remaining part. There is no multilateral debt issuance upon restructuring yet.

Table 6 presents the result of the *pro rata* split. *Partial* and *full* defaults have now similar average duration and haircut. Moreover, despite similar debt ratio and default rate, one observes a larger multilateral debt spread compared to the benchmark case. Thus, the *pro rata* split does weaken the *de facto* seniority of multilateral lenders. More precisely, the full repayment of multilateral lending institutions is a prerequisite to safeguard lending at preferential rates. However, this comes at the cost of private debt subordination implying a larger spread and haircut on the private debt.

Having shown the impact of relaxing the full repayment of multilateral lenders, I now consider that, upon restructuring, there is a net multilateral debt issuance (i.e. $b_m^j \leq 0$). Formally, one has that

$$\begin{aligned} V^{EF}(z, \boldsymbol{\epsilon}, b_m^i, W - b_m^i \bar{q}) = \max_j \ & \left\{ u(c) + \epsilon_j + \beta \mathbb{E}_{z'|z} \mathbb{E}_{\boldsymbol{\epsilon}'} V(z', \boldsymbol{\epsilon}', b_m^j, b_p^j) \right\} \\ \text{s.t.} \quad & c = y(z) + \tau, \end{aligned}$$

$$\tau = q_m(z, b_m^j, b_p^j)(-b_m^j) + q_p(z, b_m^j, b_p^j)(-b_p^j) - (W - b_m^i \bar{q}),$$
$$\tau \geq 0.$$

Thus, $b_m^j$ is not anymore restricted to be zero. This means that the sovereign's value of restructuring in a *full* default is larger than in the benchmark case. Nevertheless, the multilateral lender is still repaid in full – i.e. $-b_m^i \bar{q}$.

Table 6 presents the result of introducing multilateral debt issuance upon restructuring. As before, *partial* and *full* defaults have similar average duration and haircut. The multilateral debt spread increases but to a lesser extent than in the case of a *pro rata* split. Unlike the *pro rata* split, this comes from the larger default rate combined with the greater share of *full* default compared to the benchmark case. Thus, the the inability to issue new multilateral debt at the restructuring largely impacts the private creditors' haircut and the default duration.

Joining the multilateral debt issuance together with the *pro rata* split, I obtain a *pari passu* clause between the two types of lenders.[35] The renegotiation process under *full* default is now isomorphic to the one under *partial* default.[36] The exact outcome is in-between the above two cases, albeit closer to the *pro rata* split. As shown in Table 6, the two types of default have analogous average haircut and duration. The default rate and debt ratio are lower than in the benchmark case. Moreover, the multilateral debt spread largely increases and comes closer to the private one. Private and multilateral debt become therefore closer substitutes. As a result, the sovereign accumulates more private debt and less multilateral debt than in the benchmark case.[37] This exercise therefore shows the role of the policy of non-toleration of arrears in generating the *de facto* seniority.

## 10.4 Debt, duration and haircut

The comparison between the *de facto*, the *de jure* and the *pari passu* regimes is instructive on what is the source of longer durations and larger haircuts in the benchmark model.

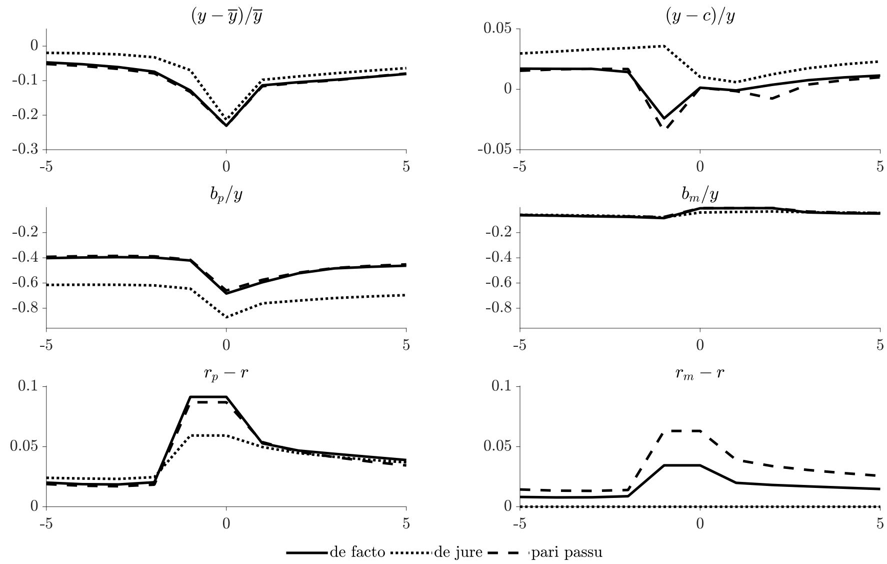
Regarding the haircut, it is clear from Table 6 that the policy of non-toleration of arrears is the key component behind larger private creditors' losses. Once one removes either the full repayment of multilateral debt (i.e. the *pro rata* split) or the non-access of multilateral

[35] In this case, the transfer upon restructuring is given by $\tau = q_m(z, b_m^j, b_p^j)(-b_m^j) + q_p(z, b_m^j, b_p^j)(-b_p^j) - W \geq 0$, where $W$ is split *pro rata*.

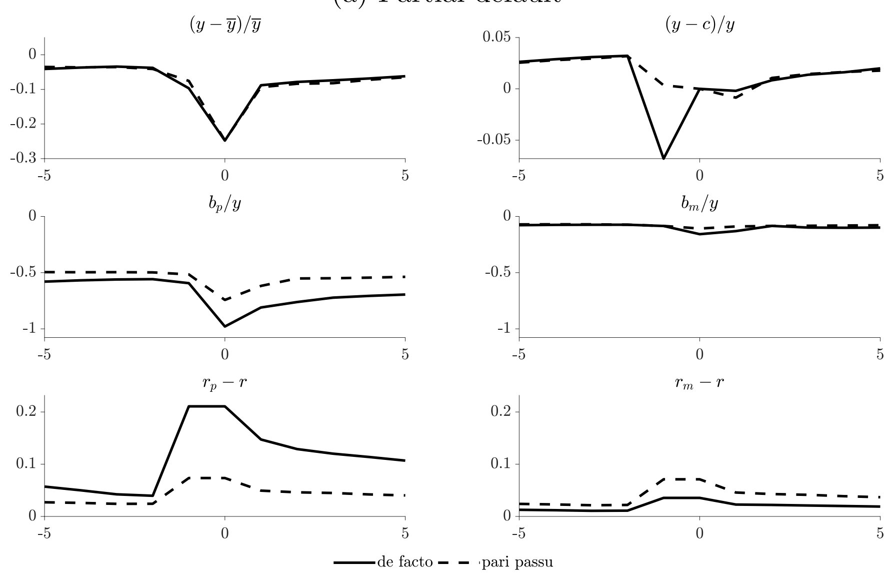
[36] The only difference is the value of autarky. Under *partial* default, the sovereign continues to service the multilateral debt in autarky.

[37] Note that if in addition to the *pari passu* clause, I equalize the output penalty between the *partial* and the *full* default, the private and multilateral debt become perfect substitutes. In this case, the share of *full* default goes to 100% and the spread equalizes between the two types of debt.

borrowing upon restructuring (i.e. $b_m^j \leq 0$), the haircut in a *full* default drastically decreases and becomes similar to the one in a *partial* default. In particular, Table 7 shows that the *de facto* seniority always generates the largest haircuts in a *full* default.




(a) Partial default




(b) Full default

*Note*: The figure depicts the evolution of endowment, trade balance, debt and spreads around defaults for the different seniority regimes. The five-year window averages come from simulation over 2000 economies for 600 periods where the initial 200 periods are discarded. Period 0 corresponds to the occurrence of default. The variable $\bar{y}$ corresponds to the average output.

Figure 7: Event Analysis in Partial and Full Defaults

Regarding the duration, what mainly explains the differential between a *full* and a *partial* default in the benchmark model is the private debt accumulation. Notably, larger total indebtedness mechanically produces longer defaults as the sovereign waits that the default risk reduces before restructuring. In addition, as I consider an exogenous borrowing limit $\mathcal{A}$, the multilateral debt has a limited impact on the total indebtedness – and therefore on the duration – when the stock of private debt is relatively large. As one can see in Figure 7a, in a *partial* default, the sovereign accumulates less private debt under the *de facto* seniority than under the *de jure* seniority. This translates into a lower *partial* default duration in the benchmark model. In opposition, as shown in Figure 7b, the sovereign accumulates a higher amount of private debt in a *full* default under the *de facto* seniority. As a result, the length of a *full* default is longer than in a *pari passu* regime.

To disentangle the effect of the larger private debt accumulation relative to the multilateral debt stock, I compute the default duration for private debt levels around $\mathcal{A}$ at $z_{min}$ for the different seniority regimes. In the benchmark model, a *full* default is always related to a longer average duration than a *partial* default. Moreover, the wedge is more pronounced when the multilateral debt is high. Besides this, under the *pari passu* regime, durations are never higher than in the *de facto* seniority.[38]

Table 7: Duration and Haircut in Partial and Full Defaults

| | Private debt | Multilateral debt | Average duration (year) | | Average haircut (%) | |
|---|---|---|---|---|---|---|
| | | | *Partial* default | *Full* default | *Partial* default | *Full* default |
| *de facto* | $\mathcal{A}$ | $\mathcal{A}$ | 1.7 | 6.3 | 6.2 | 9.2 |
| | $\mathcal{A}$ | $\mathcal{A}/3$ | 1.2 | 3.8 | 6.1 | 7.7 |
| | $\mathcal{A}/3$ | $\mathcal{A}$ | 1.1 | 5.1 | 5.0 | 6.4 |
| | $\mathcal{A}/3$ | $\mathcal{A}/3$ | 1.0 | 1.4 | 5.0 | 5.8 |
| *de jure* | $\mathcal{A}$ | $\mathcal{A}$ | 1.1 | - | 6.1 | - |
| | $\mathcal{A}$ | $\mathcal{A}/3$ | 1.1 | - | 5.9 | - |
| | $\mathcal{A}/3$ | $\mathcal{A}$ | 1.0 | - | 4.9 | - |
| | $\mathcal{A}/3$ | $\mathcal{A}/3$ | 1.0 | - | 4.9 | - |
| *pari passu* | $\mathcal{A}$ | $\mathcal{A}$ | 1.4 | 3.7 | 6.1 | 8.0 |
| | $\mathcal{A}$ | $\mathcal{A}/3$ | 1.4 | 1.9 | 6.1 | 7.6 |
| | $\mathcal{A}/3$ | $\mathcal{A}$ | 1.0 | 1.5 | 5.0 | 5.9 |
| | $\mathcal{A}/3$ | $\mathcal{A}/3$ | 1.0 | 1.2 | 5.0 | 5.4 |

*Note*: The table depicts the average duration and haircut in *partial* defaults for the different seniority regimes. The averages come from simulation over 2000 economies for 600 periods where the initial 200 periods are discarded. I fix the endowment at $z_{min}$. $\mathcal{A}$ corresponds to the multilateral borrowing limit.

Thus, in my specific calibration, the longer duration of a *full* default in the benchmark model comes from the larger private debt accumulation. The borrowing limit $\mathcal{A}$ is too tight relative to the total stock of private debt for the multilateral debt to affect the default duration directly.

[38] Notice that the larger duration in a *full* compared to a *partial* default in the *pari passu* regime can be solely attributed to the repayment of multilateral debt in autarky during a *partial* default.

Having said that, the larger private debt accumulation in a *full* default relative to a *partial* default is a consequence of the *de facto* seniority. Under the *de jure* seniority, the sovereign accumulates more debt than in the benchmark case. In opposition, under the *pari passu* clause, the sovereign accumulates less debt than in the benchmark case. Thus, the effect of multilateral debt on the *full* default duration is indirect.

This shows that different seniority regimes are associated with different behaviors in terms of debt accumulation and default. Under the *de jure* seniority, the sovereign is more reckless as both the debt ratio and the default rate are high. This is because the multilateral debt trades at the risk-free rate irrespective of the default rate. Conversely, under the *pari passu* clause, the sovereign adopts a more rigorous debt management. The reason is that the default rate directly affects the price of multilateral debt. In particular, the multilateral debt has the same repayment priority as the private debt rendering the multilateral debt price very sensitive to the default risk. The *de facto* seniority is in-between these two cases.

## 10.5 Welfare Analysis

I calculate the consumption-equivalent welfare gains with respect to the benchmark model for the sovereign. The computation of the welfare is exposed in Appendix H. I consider each of the above exercises one by one.

Table 8: Welfare Gains Relative to Benchmark

| Endowment state | Private debt | Multilateral debt | Welfare gains (%) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $\varkappa^{DF} = \varkappa^{DP}$ | *de jure* | $\mathcal{A} = 0$ | *pro rata* | $b_m^j \leq 0$ | *pari passu* |
| $z_{min}$ | High | High | 0.02 | -1.27 | - | -0.09 | -0.46 | -0.21 |
| | High | Zero | -0.27 | -0.14 | -0.10 | -0.15 | -0.15 | -0.22 |
| | Zero | High | 0.06 | 0.10 | - | 0.06 | -0.07 | 0.02 |
| | Zero | Zero | 0.06 | 0.10 | -0.20 | -0.02 | -0.06 | -0.04 |
| $z_{max}$ | High | High | 0.03 | 0.03 | - | 0.02 | 0.01 | 0.00 |
| | High | Zero | 0.03 | 0.03 | -0.09 | 0.01 | 0.00 | -0.00 |
| | Zero | High | 0.01 | -0.02 | - | 0.01 | -0.05 | 0.00 |
| | Zero | Zero | 0.01 | -0.02 | -0.02 | 0.01 | -0.05 | -0.00 |
| average | High | High | 0.04 | -0.79 | - | -0.10 | -0.58 | -0.29 |
| | High | Zero | -0.07 | -0.12 | -0.22 | -0.16 | -0.14 | -0.22 |
| | Zero | High | 0.02 | -0.03 | - | 0.03 | -0.09 | 0.01 |
| | Zero | Zero | 0.02 | -0.01 | -0.12 | 0.02 | -0.07 | -0.00 |

*Note*: The computation of the welfare is exposed in Appendix H. A high level of debt corresponds to the largest level of debt in the grid for both the private and the multilateral debt.

As shown in Table 8, an equal output penalty is associated with mostly welfare gains. The only welfare loss is recorded when there is no multilateral debt as the sovereign does not have access to a "cheap" *partial* default in which it would get a lower output penalty. However, one observes mainly welfare losses in the case of a *de jure* seniority. In regions in which debt crises occur – i.e. low endowment states with a large level of debt – losses come from the incapacity of the sovereign to repudiate its entire debt. The sovereign can only enter in *partial* default in which it continues to service the multilateral debt which adds to the default cost.

Regarding the *pari passu* clause, I find welfare losses in most states. Hence, as already argued by Hatchondo et al. (2017), the sovereign highly values the use of last-resort funds at a near risk-free rate. The *pari passu* clause weakens the *de facto* seniority of multilateral debt which is particularly valued in bad times when the default risk is high. The same holds true when I completely remove the multilateral lenders – i.e. $\mathcal{A} = 0$.

All in all, the *de facto* seniority seems to be beneficial for the sovereign. Except in a few states, the sovereign is better off than in a *de jure* or a *pari passu* regime. 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.

# 11 Conclusion

This paper uncovers the source and the consequences of the *de facto* seniority of (official) multilateral lenders – i.e. mainly the International Monetary Fund (IMF) and the World Bank (WB). I first present evidence that defaults involving such lenders are infrequent, last relatively longer and are associated with greater private haircuts.

To rationalize these findings, I augment the standard model of Eaton and Gersovitz (1981) with heterogenous creditors and endogenous restructurings. The key assumption is that the multilateral lender has a greater enforcement power than the private lenders. This greater power emanates from the larger output penalty upon default and a stringent policy of non-toleration of arrears in the spirit of the one adopted by the IMF and the WB.

Given this, the multilateral debt has an important impact on the price of private debt. On the one hand, the multilateral debt drastically reduces the private debt's recovery value owing to its repayment priority upon default. On the other hand, it can increase the sovereign's willingness to repay by rendering a *partial* default on private debt more costly. Thus, while the multilateral debt raises the subordination risk of private liabilities, it can reduce the default risk up to a certain point.

The model quantitatively matches the empirical regularities relating to the default durations, the multilateral lending rate and private creditors' haircuts. The policy of non-toleration of arrears is behind most of the model's dynamic. Such policy ensures that multilateral creditors can lend at preferential rates. Coupled with the larger output penalty, it generates important spillovers on private creditors. I find that the borrower values the use of official multilateral debt and would not necessarily prefer other seniority regimes.

My analysis focuses on multilateral lending institutions and abstracts from the Paris Club, which is a major actor in sovereign debt renegotiations. Very few studies analyze this entity which does not properly enjoy a preferred creditor status but largely impacts the private creditors' haircuts and imposes a comparability of treatment among creditors. I leave this inquiry for future work.

# References


Abbas, S. M., A. Nazim Belhocine, A. El-Ganainy, and M. Horton (2010): "A Historical Public Debt Database," *IMF Working Paper*.

Ábrahám, Á., E. Carceles-Poveda, Y. Liu, and R. Marimon (2019): "On the Optimal Design of a Financial Stability Fund," Working Paper 2018/105, ADEMU.

Aguiar, M. and M. Amador (2014): "Sovereign Debt," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, North Holland, vol. 4, 647–687.

——— (2021): *The Economics of Sovereign Debt and Default*, Princeton University Press.

Aguiar, M., S. Chatterjee, H. Cole, and Z. Stangebye (2016): "Quantitative Models of Sovereign Debt Crises," in *Handbook of Macroeconomics*, ed. by J. B. Taylor and H. Uhlig, North Holland, vol. 2, 1697–1755.

Aguiar, M. and G. Gopinath (2006): "Defaultable Debt, Interest Rates and the Current Account," *Journal of International Economics*, 69, 64–83.

Allen, M. (2008): "Staff Guidance Note on Debt Sustainability Analysis for Market Access Countries," *Prepared by the Policy Development and Review Department, International Monetary Fund*.

Arellano, C. (2008): "Default Risk and Income Fluctuations in Emerging Economies," *American Economic Review*, 98, 690–712.

Arellano, C., X. Mateos-Planas, and J.-V. Rios-Rull (2023): "Partial Default," *Journal of Political Economy*, 131.

Arellano, C. and A. Ramanarayanan (2012): "Default and the Maturity Structure in Sovereign Bonds," *Journal of Political Economy*, 120, 187–232.

Ari, A., G. Corsetti, and L. Dedola (2018): "Debt Seniority and Sovereign Debt Crises," *IMF Working Paper*.

Asonuma, T. and H. Joo (2020): "Sovereign Debt Restructurings: Delays in Renegotiations and Risk Averse Creditors," *Journal of the European Economic Association*, 18, 1–47.

Asonuma, T., D. Niepelt, and R. Ranciére (2023): "Sovereign Bond Prices, Haircuts and Maturity," *Journal of International Economics*, 140.

Asonuma, T. and C. Trebesch (2016): "Sovereign Debt Restructurings: Preemptive or Post-Default," *Journal of the European Economic Association*, 14, 175–214.

Beers, D., E. Jones, K. McDaniels, and Z. Quiviger (2022): "BoC-BoE Sovereign Default Database: What's new in 2022?" *Bank of Canada Staff Analytical Note*.

Beers, D. and J. Mavalwalla (2018): "The BoC-BoE Sovereign Default Database Revisited: What's New in 2018?" *Bank of Canada Staff Working Paper.*

Beers, D. T. and J. Chambers (2006): "Default Study: Sovereign Defaults At 26-Year Low, To Show Little Change In 2007," *Standard & Poor's CreditWeek*, 18.

Benjamin, D. and M. L. J. Wright (2013): "Recovery Before Redemption? A Theory of Delays in Sovereign Debt Renegotiations." Working Paper.

Bi, R. (2008): ""Beneficial" Delays in Debt Restructuring Negotiations," *IMF Working Papers.*

Bjørnskov, C. and M. Rode (2020): "Regime Types and Regime Change: A New Dataset on Democracy, Coups, and Political Institutions," *Review of International Organizations*, 15, 531–551.

Bolton, P. and O. Jeanne (2009): "Structuring and Restructuring Sovereign Debt: The Role of Seniority," *Review of Economic Studies*, 76, 879–902.

Boz, E. (2011): "Sovereign Default, Private Sector Creditors, and the IFIs," *Journal of International Economics*, 83, 70–82.

Broner, F. A., G. Lorenzoni, and S. L. Schmukler (2013): "Why Do Emerging Economies Borrow Short Term?" *Journal of the European Economic Association*, 11, 67–100.

Buchheit, L. C. and R. M. Lastra (2007): "Lending into Arrears – A Policy Adrift," *International Lawyer*, 41, 939–955.

Chatterjee, S. and B. Eyigungor (2012): "Maturity, Indebtedness, and Default Risk," *American Economic Review*, 102, 2674–2699.

——— (2015): "A Seniority Arrangement for Sovereign Debt," *American Economic Review*, 105, 3740–3765.

Cordella, T. and A. Powell (2021): "Preferred and Non-Preferred Creditors," *Journal of International Economics*, 132, 1–23.

Corsetti, G., B. Guimarães, and N. Roubini (2006): "International Lending of Last Resort and Moral Hazard: A Model of IMF's Catalytic Finance," *Journal of Monetary Economics*, 53, 441–471.

Cruces, J. and C. Trebesch (2013): "Sovereign Defaults: The Price of Haircuts," *American Economic Journal: Macroeconomics*, 5, 85–117.

Dell'Ariccia, G., I. Schnabel, and J. Zettelmeyer (2006): "How Do Official Bailouts Affect the Risk of Investing in Emerging Markets," *Journal of Money, Credit and Banking*, 38, 1689–1714.

Dellas, H. and D. Niepelt (2016): "Sovereign Debt with Heterogeneous Creditors," *Journal of International Economics*, 99, 16–26.

Díaz-Cassou, J., A. Erce, and J. Vázquez-Zamora (2008): "Recent Episodes of Sovereign Debt Restructurings. A Case-study Approach," *Banco de Espana Occasional Paper.*

Dreher, A. and M. Gassebner (2012): "Do IMF and World Bank Programs Induce Government Crises? An Empirical Analysis," *International Organization*, 66, 329–358.

Dvorkin, M., J. Sánchez, H. Sapriza, and E. Yurdagul (2021): "Sovereign Debt Restructurings," *American Economic Journal: Macroeconomics*, 13, 26–77.

Eaton, J. and M. Gersovitz (1981): "Debt with Potential Repudiation: Theoretical and Empirical Analysis," *Review of Economic Studies*, 48, 289–309.

Erce, A. (2014): "Banking on Seniority: The IMF and the Sovereign's Creditors," *Federal Reserve Bank of Dallas Working Papers.*

Erce, A. and E. Mallucci (2018): "Selective Sovereign Defaults," *International Finance Discussion Papers.*

Erce, A. and D. Riera-Crichton (2015): "Catalytic IMF? A Gross Flows Approach," *ESM Working*

*Paper Series*.

Finger, H. and M. Mecagni (2007): "Sovereign Debt Restructuring and Debt Sustainability: An Analysis of Recent Cross-Country Experience," *IMF Occasional Paper*.

Fink, F. and A. Scholl (2016): "A Quantitative Model of Sovereign Debt, Bailouts and Conditionality," *Journal of International Economics*, 98, 176–190.

Fischer, S. (1999): "On the Need for an International Lender of Last Resort," *Journal of Economic Perspectives*, 13, 85–104.

Fourakis, S. (2021): "Sovereign Default and Government Reputation," *University of Minnesota*.

Galli, C. (2021): "Self-Fulfilling Debt Crises, Fiscal Policy and Investment," *Journal of International Economics*, 131.

Gehring, K. and V. F. Lang (2018): "Stigma or Cushion? IMF Programs and Sovereign Creditworthiness," *CESifo Working Paper Series*.

Gelpern, A. (2004): "Building a Better Seating Chart for Sovereign Restructurings," *Emory Law Journal*, 53, 1119–1161.

Gonçalves, C. E. and B. Guimaraes (2014): "Sovereign Default Risk and Commitment for Fiscal Adjustment," *Journal of International Economics*, 95, 68–82.

Hatchondo, J. C. and L. Martinez (2009): "Long-duration Bonds and Sovereign Defaults," *Journal of International Economics*, 79, 117–125.

Hatchondo, J. C., L. Martinez, and Y. K. Onder (2017): "Non-defaultable Debt and Sovereign Risk," *Journal of International Economics*, 105, 217–229.

Hatchondo, J. C., L. Martinez, and H. Sapriza (2010): "Quantitative Properties of Sovereign Default Models: Solution Methods Matter," *Review of Economic dynamics*, 13, 919–933.

Hatchondo, J. C., L. Martinez, and C. Sosa-Padilla (2016): "Debt Dilution and Sovereign Default Risk," *Journal of Political Economy*, 124, 1383–1422.

International Bank for Reconstruction and Development (2021): "General Conditions for IBRD Financing: Program-for-Results Financing," *IBRD Policy*.

International Development Association (2007): "Further Elaboration of a Systematic Approach to Arrears Clearance," *Resource Mobilization Department*.

International Monetary Fund (1988): "Communique of the Interim Committee of the Board of Governors of the IMF," *IMF Press Release*.

——— (1989): *Selected Decisions of the International Monetary Fund*, vol. 14, Washington, D. C.: International Monetary Fund.

——— (1999): "IMF Policy on Lending into Arrears to Private Creditors," *Policy Development and Review and Legal Departments*.

——— (2015): "Reforming the Fund's Policy on Non-Toleration of Arrears to Official Creditors," *IMF Policy Papers*.

Jeanne, O. and J. Zettelmeyer (2001): "International Bailouts, Moral Hazard and Conditionality," *Economic Policy*, 16, 407–432.

Krahnke, T. (2020): "Doing More With Less: The Catalytic Function of IMF Lending and the Role of Program Size," *Deutsche Bundesbank Discussion Paper*.

Krueger, A. O. (2001): "International Financial Architecture for 2002: A New Approach to Sovereign Debt Restructuring," *Address given at the National Economists' Club Annual Members' Dinner, Washington, D.C.*

Lindert, P. H. and P. J. Morton (1989): "How Sovereign Debt Has Worked," in *Developing Country Debt and Economic Performance: The International Financial System*, ed. by J. Sachs, Chicago: University of Chicago Press, vol. 1.

Liu, Y., R. Marimon, and A. Wicht (2020): "Making Sovereign Debt Safe with a Financial Stability Fund," .

Martha, R. S. J. (1990): "Preferred Creditor Status under International Law: The Case of the International Monetary Fund," *International and Comparative Law Quarterly*, 39, 801–826.

Mateos-Planas, X., S. McCrary, J.-V. Rios-Rull, and A. Wicht (2022): "The Generalized Euler Equation and the Bankruptcy-Sovereign Default Problem," .

Mendoza, E. and V. Z. Yue (2012): "A General Equilibrium Model of Sovereign Default and Business Cycle," *Quarterly Journal of Economics*, 127, 889–946.

Merlo, A. and C. Wilson (1995): "A Stochastic Model of Sequential Bargaining with Complete Information," *Econometrica*, 63, 371–399.

Mihalache, G. (2020): "Sovereign Default Resolution through Maturity Extension," *Journal of International Economics*, 125, 103–126.

Morris, S. and H. S. Shin (2006): "Catalytic Finance: When Does It Work?" *Journal of International Economics*, 70, 161–177.

Niepelt, D. (2014): "Debt Maturity Without Commitment," *Journal of Monetary Economics*, 68, 37–54.

Panizza, U., F. Sturzenegger, and J. Zettelmeyer (2009): "The Economics and Law of Sovereign Debt and Default," *Journal of Economic Literature*, 47, 651–698.

Raffer, K. (2009): "Preferred or Not Preferred: Thoughts on Priority Structures of Creditors." *Unpublished Document Prepared for Discussion at the 2nd Meeting of the ILA Sovereign Insolvency Study Group.*

Reinhart, C. and K. Rogoff (2009): *This Time is Different: Eight Centuries of Financial Folly*, Princeton: Princeton Univeristy Press.

Reinhart, C. M. and K. S. Rogoff (2004): "Serial Default and the "Paradox" of Rich-to-Poor Capital Flows," *American Economic Review*, 94, 53–58.

Reinhart, C. M. and C. Trebesch (2016): "The International Monetary Fund: 70 Years of Reinvention," *Journal of Economic Perspectives*, 30, 3–28.

Rieffel, L. (2003): *Restructuring Sovereign Debt: The Case for Ad Hoc Machinery*, Washington, D.C.: Brooking Institute Press.

Rochet, J.-C. and X. Vives (2010): "Coordination Failures and the Lender of Last Resort: Was Bagehot Right after All," *Journal of the European Economic Association*, 2, 1116–1147.

Roubini, N. and B. Setser (2003): "Seniority of Sovereign Debts," in *Bailouts or Bail-ins? Responding to Financial Crises in Emerging Economies*, Peterson Institute for International Economics, chap. 7, 249–287.

Rust, J. (1988): "Statistical Models of Discrete Choice Processes," *Transportation Research Part B: Methodological*, 22, 125–158.

Saravia, D. (2013): "Vulnerability, Crises and Debt Maturity: Do IMF Interventions Increase Reliance on Short-Term Debt?" *International Finance*, 16, 311–331.

Sarkees, M. R. and F. Wayman (2010): *Resort to War: 1816 - 2007*, Washington D.C.: CQ Press.

Schadler, S. (2014): "The IMF's Preferred Creditor Status: Does It Still Make Sense After the Euro Crisis," *CIGI Policy Brief*.

Schlegl, M., C. Trebesch, and M. L. J. Wright (2019): "The Seniority Structure of Sovereign Debt," Working Paper Series 7632, CESifo.

Schumacher, J., C. Trebesch, and H. Enderlein (2021): "Sovereign Defaults in Court," *Journal of International Economics*, 131, 1–45.

Standard & Poor's (2000): "Securitization in Latin America 2000," *Structured Finance*.

Sturzenegger, F. and J. Zettelmeyer (2008): "Haircuts: Estimating Investor Losses in Sovereign Debt Restructurings," *Journal of international Money and Finance*, 27, 780–805.

Tauchen, G. (1986): "Finite State Markov-Chain Approximations to Univariate and Vector Autoregressions," *Economic Letters*, 20, 177–181.

Tomz, M. and M. L. J. Wright (2007): "Do Countries Default in 'Bad Times'?" *Journal of the European Economic Association*, 5, 352–360.

——— (2013): "Empirical Research on Sovereign Debt and Default," *Annual Review of Economics*, 5, 247–272.

Trebesch, C. (2008): "Delays in Sovereign Debt Restructurings: Should We Really Blame the Creditors?" *Proceedings of the German Development Economics Conference, Zurich*.

——— (2011): "Sovereign Default and Crisis Resolution," *Ph.D. dissertation, Free University Berlin*.

Yue, V. Z. (2010): "Sovereign Default and Debt Renegotiation," *Journal of International Economics*, 80, 176–187.

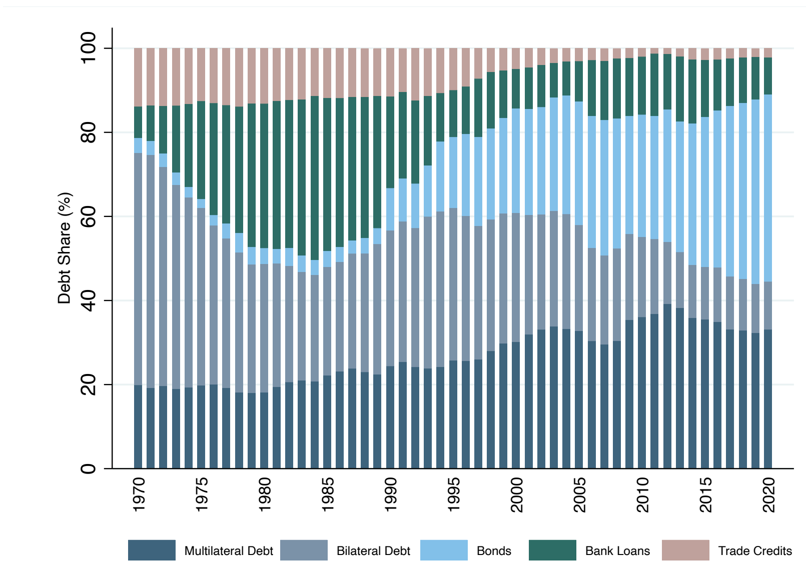
Zettelmeyer, J., C. Trebesch, and M. Gulati (2014): "The Greek Debt Restructuring: An Autopsy," *Economic Policy*, 28, 513–563.

Zwart, S. (2007): "The Mixed Blessing of IMF Intervention: Signalling Versus Liquidity Support," *Journal of Financial Stability*, 3, 149–174.

# Appendix

## A Additional Tables and Figures

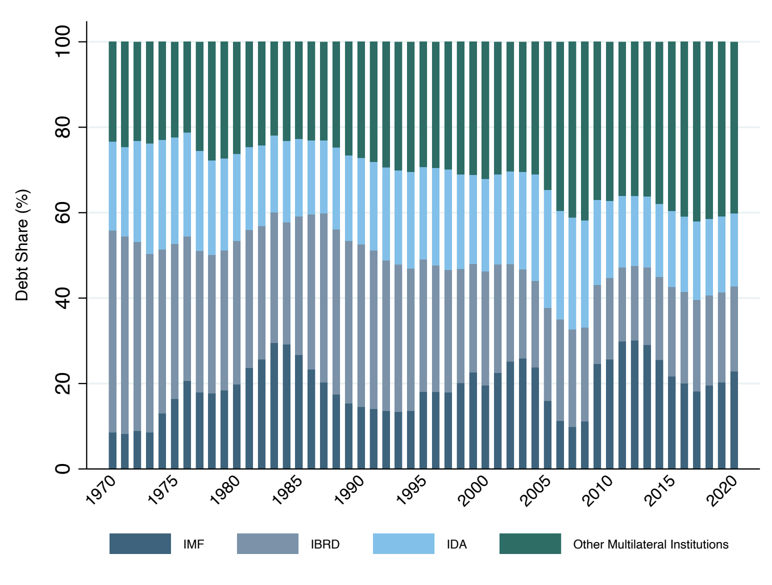
This section presents additional tables and figures. Figure A.1 presents the composition of the sovereign debt excluding advanced economies. One observes significant changes over the years. While in the 1970s, bilateral loans represented the biggest share of the pie, it is now the smallest with bank loans and trade credits. In opposition, bonds which were rare in the 1970s are now the largest part of the sovereign debt. The switch appeared in the 1990s after the numerous defaults on bank loans especially in Latin American and the emergence of Brady bonds. The multilateral debt has always been important representing 20% of the total in the 1970s. It has followed a growing trend over the past decades and amounts now roughly 35% of the total sovereign debt.




*Note*: Multilateral debt refers to loans from official institutions such as the IMF, the IBRD, the IDA, regional development bank and other intergovernmental agencies. Bilateral debt refers to loans from other sovereign governments.
*Source*: Schlegl et al. (2019), WB, author's calculation.

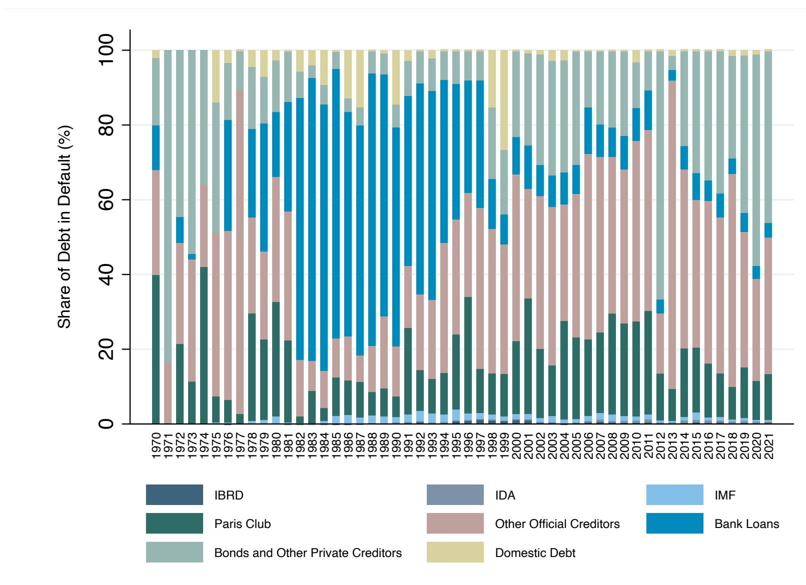
Figure A.1: Structure of Sovereign Debt

Figure A.2 presents the composition of the multilateral sovereign debt excluding advanced economies. Two main elements deserve to be noted. First, the share of debt held by the IMF and WB (i.e. the IBRD and the IDA) represents the majority of the total. Notably, one observes that the share of the IMF was the largest in the 1980s, while the WB has dominated the scene of multilateral lending until the beginning of the 21st century. For the IMF specifically, one sees a large drop of its share in the second half of the Great Moderation before rebounding with the Great Financial crisis of 2007-2008.




*Note*: Other Multilateral Institutions refer to loans from regional development bank and other intergovernmental agencies different from the IMF, the IBRD and the IDA.
*Source*: Schlegl et al. (2019), WB, author's calculation.

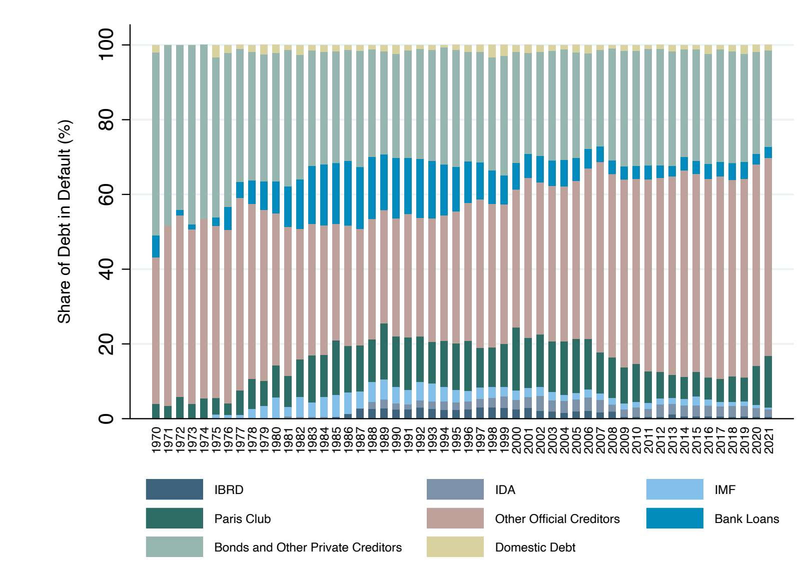
Figure A.2: Structure of Multilateral Sovereign Debt




*Source*: Beers et al. (2022), author's calculation.

Figure A.3: Debt in Default by Creditors

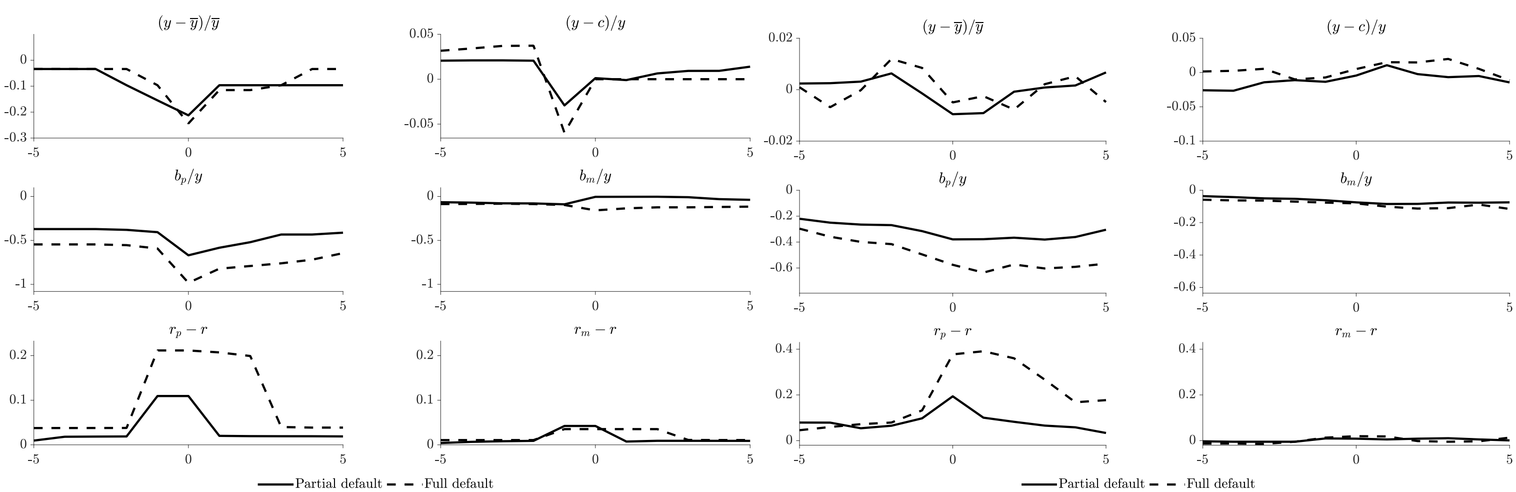
Figure A.3 presents the breakdown of debt in default by creditors. One directly sees that the IMF and the WB represent a negligible share throughout the entire sample. The two entities combined never represented more than 4% of the total amount of debt in default. This is however not the case for the Paris Club and the other official creditors which account for a large share of defaulted debt in the 1970s and in the last two decades depicted. Another large share of the pie goes to the private creditors especially in the 1980s through bank loans and in the 1990s-2000s through bonds.




*Source*: Beers et al. (2022), author's calculation.

Figure A.4: Countries in Default by Creditors

Figure A.4 presents the breakdown of countries in default by creditors. As in the previous figure, I note very few countries in default on the IMF and the WB. The two institutions combined never accounted for more than 11% of the countries in default. In opposition, the Paris Club and the other official creditors are involved once more in a big part of the defaults. The same holds true for private creditors.




(a) Model (b) Data

Figure A.5: Event Analysis – Median

Figure A.5 presents the event analysis described in Section 10 where I take the median instead of the average. The dynamic is similar to the one depicted in Figure 6 for both the model and the data.

# B Data

This section presents the different sources of data used in the empirical analysis and for the calibration of the model. Generally, there are three main sources of data.

First, for the duration of the default, I rely on the restructurings' dates contained in Asonuma and Trebesch (2016). A restructuring starts whenever a sovereign misses some payments beyond any contract-specified grace period, or if the sovereign undergoes renegotiations of the original debt contract.[39] Conversely, a restructuring ends with the official settlement announcement or the implementation of the debt exchange.[40]

Second, given the above default duration, I retrieve the creditors involved in each default by means of the database of Beers et al. (2022). The dataset specifies 9 types of foreign creditors: the IMF, the IBRD, the IDA, the Paris Club, China, other official creditors, banks, bondholders and other private creditors. I merge the IMF, the IBRD and the IDA together under the label of multilateral creditors. I also group China together with other official creditors. Finally, I add bondholders and other private creditors together.[41] I therefore end up with 5 dummies: multilateral creditors, Paris Club, other official creditors, bank loans and bonds and other private creditors. Table B.1 indicates the default episodes with multilateral lenders.

Finally, haircut statistics on private creditors are retrieved from Cruces and Trebesch (2013).[42] The database contains information about defaulted amounts and haircuts of defaults on external private debt from 1970 to 2014. I use two specifications of the haircut. The first one is the market haircut and is the one used by many financial institutions such as credit rating agencies as well as official lenders. The second one is computed according to Sturzenegger and Zettelmeyer (2008) and is becoming the standard in the empirical literature on sovereign defaults. The haircuts account for private creditors (i.e. bondholders and banks) and disregard official creditors (e.g. the IMF, the WB, the Paris Club).

With the above data, I obtain a dataset containing the start and the end date of each default in months with the underlying haircut on private creditors and that for a total of 187

[39]This definition follows the one of Standard & Poor's (Beers and Chambers, 2006).

[40]This definition may differ from the one of Standard & Poor's which defines the end of a restructuring when a settlement occurs with no prospects of further resolutions (Beers and Chambers, 2006).

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

[42]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).

default episodes between 1970 and 2014. Furthermore, for each default episode, I identify which types of creditor is involved. I find that overall 33 default episodes involve multilateral creditors. That is the country defaulted on such creditors.[43] Table B.1 depicts the sample used in the analysis.

Table B.1: Sample

| Country | Default Start | Default End | Duration | SZ Haircut | Multilateral Creditor Default |
|---|---|---|---|---|---|
| Albania | 01.11.1991 | 31.08.1995 | 3.8 | 80.4 | No |
| Algeria | 01.10.1990 | 01.03.1992 | 1.5 | 8.7 | No |
| Algeria | 01.12.1993 | 17.07.1996 | 2.7 | 23.5 | No |
| Argentina | 01.07.1982 | 27.08.1985 | 3.2 | 30.3 | No |
| Argentina | 01.08.1985 | 21.08.1987 | 2.1 | 21.7 | No |
| Argentina | 01.01.1988 | 07.04.1993 | 5.3 | 32.5 | No |
| Argentina | 01.11.2001 | 10.06.2005 | 3.7 | 76.8 | Yes |
| Belize | 02.08.2006 | 20.02.2007 | 0.6 | 23.7 | No |
| Belize | 31.08.2012 | 01.03.2013 | 0.7 | 31.5 | No |
| Bolivia | 01.09.1980 | 17.03.1988 | 7.6 | 92.7 | Yes |
| Bolivia | 01.04.1988 | 01.04.1993 | 5.1 | 76.5 | Yes |
| Bosnia & Herzegovina | 01.06.1992 | 09.12.1997 | 5.6 | 89.6 | Yes |
| Brazil | 01.12.1982 | 25.02.1983 | 0.3 | -9.8 | No |
| Brazil | 01.01.1983 | 27.01.1984 | 1.1 | 1.7 | No |
| Brazil | 01.06.1984 | 05.09.1986 | 2.3 | 19.2 | No |
| Brazil | 01.09.1986 | 11.11.1988 | 2.3 | 18.4 | No |
| Brazil | 01.06.1989 | 20.11.1992 | 3.5 | 27.0 | No |
| Brazil | 01.06.1989 | 15.04.1994 | 4.9 | 29.3 | No |
| Bulgaria | 01.03.1990 | 29.06.1994 | 4.3 | 56.3 | No |
| Cameroon | 01.06.1985 | 01.08.2003 | 18.3 | 85.5 | No |
| Chile | 01.01.1983 | 01.11.1983 | 0.9 | 0.7 | No |
| Chile | 01.01.1983 | 25.01.1984 | 1.1 | 8.4 | No |
| Chile | 01.08.1984 | 14.04.1986 | 1.8 | 31.7 | No |
| Chile | 01.10.1986 | 17.06.1987 | 0.8 | 14.3 | No |
| Chile | 01.04.1990 | 12.12.1990 | 0.8 | 17.0 | No |
| Costa Rica | 15.07.1981 | 10.09.1983 | 2.3 | 39.4 | No |
| Costa Rica | 01.10.1984 | 27.05.1985 | 0.7 | 35.6 | No |
| Costa Rica | 01.05.1986 | 21.05.1990 | 4.1 | 71.9 | No |
| Croatia | 01.12.1991 | 31.07.1996 | 4.7 | 11.0 | No |
| Cuba | 01.09.1983 | 30.12.1983 | 0.3 | 42.9 | No |
| Cuba | 01.01.1984 | 24.12.1984 | 1.0 | 44.2 | No |
| Cuba | 01.01.1985 | 19.09.1985 | 0.8 | 49.5 | No |
| Côte d'Ivoire | 01.06.1983 | 01.03.1998 | 14.8 | 62.8 | No |
| Côte d'Ivoire | 01.03.2000 | 16.04.2010 | 10.2 | 55.2 | Yes |
| Côte d'Ivoire | 31.01.2011 | 12.11.2012 | 1.9 | 6.1 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1975 | 12.04.1980 | 4.9 | 29.6 | Yes |
| Dem. Rep. of Congo (Kinshasa) | 01.04.1982 | 29.01.1983 | 0.8 | 38.2 | Yes |
| Dem. Rep. of Congo (Kinshasa) | 01.02.1983 | 01.06.1984 | 1.4 | 30.1 | Yes |
| Dem. Rep. of Congo (Kinshasa) | 01.09.1984 | 01.05.1985 | 0.8 | 37.0 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1985 | 01.05.1986 | 1.0 | 35.4 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1986 | 20.05.1987 | 1.0 | 26.8 | No |
| Dem. Rep. of Congo (Kinshasa) | 01.06.1987 | 01.06.1989 | 2.1 | 50.6 | Yes |
| Dominica | 01.07.2003 | 15.06.2004 | 1.0 | 54.0 | No |
| Dominican Republic | 01.06.1982 | 24.02.1986 | 3.8 | 49.9 | No |
| Dominican Republic | 01.06.1987 | 30.08.1994 | 7.3 | 50.5 | No |
| Dominican Republic | 01.04.2004 | 11.05.2005 | 1.2 | 4.7 | No |
| Dominican Republic | 01.08.2004 | 18.10.2005 | 1.3 | 11.3 | No |
| Ecuador | 08.10.1982 | 14.10.1983 | 1.1 | 6.3 | No |
| Ecuador | 01.12.1983 | 09.08.1984 | 0.8 | 5.7 | No |
| Ecuador | 01.08.1984 | 11.12.1985 | 1.4 | 15.4 | No |
| Ecuador | 01.08.1986 | 28.02.1995 | 8.6 | 42.2 | No |
| Ecuador | 28.01.1999 | 23.08.2000 | 1.7 | 38.3 | No |
| Ecuador | 14.11.2008 | 03.06.2009 | 0.7 | 67.7 | No |
| Ethiopia | 01.06.1990 | 16.01.1996 | 5.7 | 92.0 | No |
| Gabon | 15.09.1986 | 01.12.1987 | 1.3 | 7.9 | No |
| Gabon | 01.06.1989 | 16.05.1994 | 5.0 | 16.2 | No |
| Gambia | 01.06.1984 | 15.02.1988 | 3.8 | 49.3 | Yes |
| Greece | 01.07.2011 | 13.03.2012 | 0.8 | 64.6 | No |
| Grenada | 01.10.2004 | 16.11.2005 | 1.2 | 33.9 | No |
| Guinea | 01.06.1985 | 20.04.1988 | 2.9 | 26.1 | No |
| Guinea | 01.06.1991 | 01.12.1998 | 7.6 | 87.0 | No |
| Guyana | 01.06.1982 | 24.11.1992 | 10.5 | 89.2 | Yes |
| Guyana | 01.01.1993 | 01.12.1999 | 7.0 | 91.0 | No |

| Country | Default Start | Default End | Duration | SZ Haircut | Multilateral Creditor Default |
|---|---|---|---|---|---|
| Honduras | 01.06.1981 | 01.10.1989 | 8.4 | 73.2 | Yes |
| Honduras | 01.06.1990 | 01.08.2001 | 11.3 | 82.0 | Yes |
| Iraq | 01.09.1986 | 01.01.2006 | 19.4 | 89.4 | Yes |
| Jamaica | 01.06.1977 | 01.09.1978 | 1.3 | 2.2 | No |
| Jamaica | 01.05.1978 | 01.04.1979 | 1.0 | 3.5 | No |
| Jamaica | 01.03.1980 | 20.06.1981 | 1.3 | 15.2 | Yes |
| Jamaica | 01.06.1983 | 01.06.1984 | 1.1 | 18.1 | Yes |
| Jamaica | 01.07.1984 | 01.09.1985 | 1.3 | 31.7 | No |
| Jamaica | 01.09.1986 | 07.05.1987 | 0.8 | 32.8 | Yes |
| Jamaica | 01.01.1990 | 26.06.1990 | 0.5 | 44.0 | No |
| Jordan | 01.02.1989 | 23.12.1993 | 4.9 | 54.6 | No |
| Kenya | 01.01.1992 | 02.06.1998 | 6.5 | 45.7 | No |
| Liberia | 01.11.1980 | 01.12.1982 | 2.2 | 35.7 | No |
| Liberia | 01.12.1981 | 01.04.2009 | 27.4 | 97.0 | Yes |
| Macedonia | 01.05.1992 | 26.03.1997 | 4.9 | 34.6 | Yes |
| Madagascar | 01.05.1981 | 01.11.1981 | 0.6 | 19.0 | No |
| Madagascar | 01.06.1982 | 25.10.1984 | 2.4 | 41.3 | No |
| Madagascar | 01.06.1985 | 15.06.1987 | 2.1 | 13.7 | No |
| Madagascar | 01.06.1987 | 10.04.1990 | 2.9 | 52.7 | No |
| Malawi | 12.07.1982 | 06.03.1983 | 0.8 | 28.5 | No |
| Malawi | 01.08.1987 | 04.10.1988 | 1.3 | 39.2 | No |
| Mauritania | 01.06.1992 | 01.08.1996 | 4.3 | 90.0 | No |
| Mexico | 01.08.1982 | 27.08.1983 | 1.1 | -0.2 | No |
| Mexico | 01.05.1984 | 29.03.1985 | 0.9 | 2.2 | No |
| Mexico | 01.05.1984 | 29.08.1985 | 1.3 | 5.4 | No |
| Mexico | 02.09.1986 | 01.03.1987 | 0.6 | 18.1 | No |
| Mexico | 01.08.1987 | 01.03.1988 | 0.7 | 56.3 | No |
| Mexico | 01.12.1988 | 04.02.1990 | 1.3 | 30.5 | No |
| Moldova | 01.06.2001 | 17.06.2004 | 3.1 | 56.3 | No |
| Moldova | 12.06.2002 | 29.10.2002 | 0.4 | 36.9 | No |
| Morocco | 25.08.1983 | 01.02.1986 | 2.6 | 23.5 | No |
| Morocco | 22.10.1985 | 23.09.1987 | 2.0 | 21.3 | No |
| Morocco | 01.02.1989 | 01.09.1990 | 1.7 | 40.3 | No |
| Mozambique | 01.06.1983 | 27.12.1991 | 8.6 | 90.0 | No |
| Mozambique | 01.03.1993 | 01.09.2007 | 14.6 | 91.0 | No |
| Nicaragua | 01.09.1978 | 01.12.1980 | 2.3 | 26.1 | No |
| Nicaragua | 01.06.1981 | 01.12.1981 | 0.6 | 48.5 | No |
| Nicaragua | 01.06.1982 | 01.03.1982 | -0.2 | 56.3 | No |
| Nicaragua | 01.03.1983 | 01.02.1984 | 1.0 | 41.7 | Yes |
| Nicaragua | 01.04.1985 | 01.11.1995 | 10.7 | 92.0 | Yes |
| Nicaragua | 01.01.1995 | 01.12.2007 | 13.0 | 95.5 | No |
| Niger | 01.06.1983 | 09.03.1984 | 0.8 | 37.4 | No |
| Niger | 01.06.1984 | 01.04.1986 | 1.9 | 45.8 | No |
| Niger | 01.06.1986 | 08.03.1991 | 4.8 | 82.0 | No |
| Nigeria | 01.08.1982 | 01.07.1983 | 1.0 | 2.1 | No |
| Nigeria | 01.08.1982 | 01.09.1983 | 1.2 | 1.2 | No |
| Nigeria | 01.10.1983 | 01.04.1984 | 0.6 | -2.8 | No |
| Nigeria | 01.01.1986 | 23.11.1987 | 1.9 | 19.3 | No |
| Nigeria | 01.10.1987 | 01.01.1988 | 0.3 | 41.5 | No |
| Nigeria | 01.03.1988 | 01.06.1989 | 1.3 | 30.1 | No |
| Nigeria | 01.06.1989 | 20.12.1991 | 2.6 | 40.1 | No |
| Pakistan | 01.07.1998 | 12.12.1999 | 1.5 | 11.6 | No |
| Pakistan | 30.01.1999 | 13.12.1999 | 1.0 | 15.0 | No |
| Panama | 01.11.1984 | 01.10.1985 | 1.0 | 12.0 | No |
| Panama | 01.03.1987 | 01.08.1994 | 7.5 | 15.1 | Yes |
| Panama | 01.03.1987 | 17.04.1996 | 9.2 | 34.9 | Yes |
| Paraguay | 01.01.1986 | 01.07.1993 | 7.6 | 29.2 | No |
| Peru | 01.03.1976 | 01.12.1978 | 2.8 | -7.2 | No |
| Peru | 01.09.1979 | 01.01.1980 | 0.4 | -4.6 | No |
| Peru | 01.03.1983 | 01.07.1983 | 0.4 | 6.3 | No |
| Peru | 01.06.1984 | 07.03.1997 | 12.8 | 63.9 | Yes |
| Philippines | 01.10.1983 | 01.04.1986 | 2.6 | 42.6 | No |
| Philippines | 01.09.1986 | 01.12.1987 | 1.3 | 15.4 | No |

| Country | Default Start | Default End | Duration | SZ Haircut | Multilateral Creditor Default |
|---|---|---|---|---|---|
| Philippines | 01.07.1988 | 01.02.1990 | 1.7 | 42.8 | No |
| Philippines | 01.07.1990 | 01.12.1992 | 2.5 | 25.4 | No |
| Poland | 01.03.1981 | 06.04.1982 | 1.2 | 40.6 | No |
| Poland | 01.01.1982 | 04.11.1982 | 0.9 | 62.9 | No |
| Poland | 01.12.1982 | 04.11.1983 | 1.0 | 52.5 | No |
| Poland | 01.12.1983 | 13.07.1984 | 0.7 | 26.9 | No |
| Poland | 01.01.1986 | 01.09.1986 | 0.8 | 37.5 | No |
| Poland | 01.10.1986 | 20.07.1988 | 1.8 | 24.4 | No |
| Poland | 01.08.1988 | 01.07.1989 | 1.0 | 12.0 | No |
| Poland | 01.10.1989 | 27.10.1994 | 5.1 | 49.0 | No |
| Rep. Of Congo (Brazzaville) | 01.06.1983 | 27.02.1988 | 4.8 | 42.3 | No |
| Rep. Of Congo (Brazzaville) | 01.03.1988 | 14.12.2007 | 19.8 | 90.8 | Yes |
| Romania | 01.09.1981 | 07.12.1982 | 1.3 | 32.9 | Yes |
| Romania | 01.01.1983 | 20.06.1983 | 0.5 | 31.7 | No |
| Romania | 01.06.1986 | 01.09.1986 | 0.3 | 12.3 | Yes |
| Russia | 01.08.1991 | 01.12.1997 | 6.4 | 26.2 | No |
| Russia | 17.08.1998 | 07.05.1999 | 0.8 | 46.0 | No |
| Russia | 20.11.1998 | 25.08.2000 | 1.8 | 50.8 | No |
| Russia | 20.04.1999 | 03.02.2000 | 0.9 | 51.5 | No |
| Senegal | 01.05.1981 | 01.02.1984 | 2.8 | 28.8 | No |
| Senegal | 01.06.1985 | 07.05.1985 | 0.1 | 31.3 | No |
| Senegal | 01.06.1990 | 28.09.1990 | 0.3 | 35.7 | No |
| Senegal | 01.06.1992 | 18.12.1996 | 4.6 | 92.0 | No |
| Serbia | 01.06.1992 | 22.07.2004 | 12.2 | 70.9 | Yes |
| Seychelles | 01.07.2008 | 11.02.2010 | 1.7 | 56.2 | No |
| Sierra Leone | 01.06.1980 | 01.08.1995 | 15.3 | 88.6 | Yes |
| Slovenia | 01.06.1992 | 12.03.1996 | 3.8 | 3.3 | No |
| South Africa | 01.09.1985 | 24.03.1987 | 1.6 | 8.5 | No |
| South Africa | 01.06.1989 | 18.10.1989 | 0.4 | 12.7 | No |
| South Africa | 01.01.1992 | 27.09.1993 | 1.8 | 22.0 | No |
| St. Kitts & Nevis | 01.06.2011 | 01.04.2012 | 0.9 | 62.9 | No |
| Sudan | 01.06.1975 | 01.10.1985 | 10.4 | 54.6 | Yes |
| São Tomé and Príncipe | 01.06.1984 | 01.08.1994 | 10.3 | 90.0 | No |
| Tanzania | 01.06.1981 | 01.01.2004 | 22.7 | 88.0 | Yes |
| Togo | 01.06.1987 | 01.05.1988 | 1.0 | 46.0 | No |
| Togo | 01.06.1991 | 01.12.1997 | 6.6 | 92.3 | No |
| Trinidad & Tobago | 01.09.1988 | 20.12.1989 | 1.3 | 15.5 | No |
| Turkey | 01.12.1976 | 01.06.1979 | 2.6 | 22.2 | No |
| Turkey | 02.12.1976 | 22.08.1979 | 2.8 | 19.5 | No |
| Turkey | 01.01.1981 | 01.08.1981 | 0.7 | 8.6 | No |
| Turkey | 01.01.1981 | 13.03.1982 | 1.3 | 17.0 | No |
| Uganda | 01.06.1979 | 26.02.1993 | 13.8 | 88.0 | No |
| Ukraine | 12.08.1998 | 21.09.1998 | 0.2 | 11.8 | No |
| Ukraine | 12.08.1998 | 20.10.1998 | 0.3 | 14.7 | No |
| Ukraine | 18.05.1999 | 20.08.1999 | 0.3 | -8.3 | No |
| Ukraine | 10.01.2000 | 07.04.2000 | 0.3 | 18.0 | No |
| Uruguay | 01.01.1983 | 29.07.1983 | 0.6 | 0.7 | No |
| Uruguay | 01.04.1985 | 10.07.1986 | 1.3 | 24.3 | No |
| Uruguay | 01.05.1987 | 04.03.1988 | 0.9 | 20.3 | No |
| Uruguay | 01.07.1989 | 31.01.1991 | 1.6 | 26.3 | No |
| Uruguay | 11.03.2003 | 29.05.2003 | 0.3 | 9.8 | No |
| Venezuela | 01.03.1983 | 27.02.1986 | 3.0 | 9.9 | No |
| Venezuela | 24.04.1986 | 18.09.1987 | 1.5 | 4.3 | No |
| Venezuela | 12.01.1989 | 05.12.1990 | 2.0 | 36.7 | No |
| Vietnam | 01.01.1982 | 05.12.1997 | 16.0 | 52.0 | Yes |
| Yemen | 01.06.1983 | 01.02.2001 | 17.8 | 97.0 | No |
| Yugoslavia | 01.01.1983 | 09.09.1983 | 0.8 | 6.5 | No |
| Yugoslavia | 01.09.1983 | 16.05.1984 | 0.8 | -7.5 | No |
| Yugoslavia | 01.06.1984 | 18.12.1985 | 1.6 | 14.5 | No |
| Yugoslavia | 01.07.1987 | 21.09.1988 | 1.3 | 19.7 | No |
| Zambia | 07.01.1983 | 14.09.1994 | 11.8 | 89.0 | Yes |

I complement my datasets with other data presented in Table B.2. First, I use UN data for national accounting statistics. For many of the countries covered in my analysis the default's start coincides with a major political revolution (e.g. Yemen), a civil war (e.g. Liberia and Ethiopia), an independence or a dismantlement (e.g. former Yugoslavia). The UN keeps track record of the different political entities and their evolution. Hence, compared to the WB's WDI database it is possible to obtain data on former political entities.

Second, statistics on the countries' external debt comes mainly from the WB's WDI and IDS. The WB provides a breakdown of debt by creditor types: multilateral, bilateral and private. However, the time and geographic coverage is imperfect. Regarding private debt, complementing the dataset with the IMF's historical public debt database of Abbas et al. (2010) does not fill all the missing values. Hence, I do not integrate such variable in the

[43] 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 Cruces and Trebesch (2013).

regression analysis. Regarding multilateral debt, I retrieve the level of IMF debt by means of the "use of IMF credit". The WB debt is simply formed by the sum of IBRD loans and IDA credits. Missing values are filled by the joint BIS-IMF-OECD-WB Statistics and newspaper articles from the New York Times archives.[44]

Table B.2: Data Source

| Item | Details | Source | Comments |
|---|---|---|---|
| National accounts | Nominal GDP (USD)<br>Real GDP (2015 USD)<br>Real GDP per capita (2015 USD)<br>Real consumption (2015 USD)<br>Real exports of goods and services (2015 USD)<br>Real imports of goods and services (2015 USD) | UN | Consistent with PWT and World Bank data |
| Debt | External debt stock (current USD)<br>Debt service on external debt (current USD)<br>PPG, commercial banks (current USD)<br>PPG, bonds (current USD)<br>PPG, other private creditors (current USD)<br>PPG, IBRD (current USD)<br>PPG, IDA (current USD)<br>PPG, bilateral (current USD)<br>PPG, multilateral (current USD)<br>IBRD loans and IDA credits<br>Use of IMF credit (current USD) | World Bank | |
| | External debt stock (% of GDP) | Abbas et al. (2010) | Covers some missing World Bank data |
| | IMF Loans (current USD) | Joint BIS, IMF, OECD and World Bank | Covers IMF debt missing data |
| | Multilateral Loans (current USD) | Joint BIS, IMF, OECD and World Bank | Covers multilateral debt missing data |
| | Multilateral debt | New York Times Archives | Covers remaining missing data for Cuba (1983-1985), Iraq (1986-2006), Poland (1981-1994) and all the former republics of Yugoslavia (1983-1988, 1992-1997) |
| EMBI+ spread | | World Bank, Global Financial Data | Only available from 1997 |
| IBRD lending rate | | World Bank | Average across sample, when no rate available take 5-year Libor plus 1.5 spread |
| IDA service charge | | World Bank | |
| IMF adjusted rate of charge | | IMF | |
| Yield on 1-year US government bond | Real Yield curve rate | US Treasury | Only available from 1990 |
| 10-year US Treasury rate | 10-year US Treasury constant maturity rate | Federal Reserve Bank of St. Louis | |
| US PCE inflation rate | Personal Consumption Expenditures inflation rate | Federal Reserve Bank of St. Louis | |
| Federal Funds rate | | Federal Reserve Bank of St. Louis | |
| Haircut, private creditors | Preferred haircut (Sturzenegger and Zettelmeyer, 2008)<br>Market haircut | Cruces and Trebesch (2013) | With 2014 update |
| Creditors involved | Default by creditor groups | Beers et al. (2022) | |
| IMF program<br>World Bank adjustment loan | IMF's SAF, PRGF or SBA program in effect for at least 5 months<br>World Bank's adjustement loans in effect for at least 5 months | Dreher and Gassebner (2012) | Extended to 2014 using IMF MONA database and World Bank Projects & Operations |
| Default duration | Default's start and end date (month and year) | Asonuma and Trebesch (2016)<br>Beers and Chambers (2006) | Definition of Standard & Poor's |
| War | Inter-state wars<br>Intra-state wars | Sarkees and Wayman (2010) | Dummy variables |
| Political Regime | Regime type (communist, dictatorship)<br>Regime change (election, postponed election, coup) | Bjørnskov and Rode (2020) | Dummy variables |

As the focus of the analysis is the IMF and the WB, it is important to account for their respective programs and projects financing in the sample countries. For this purpose, I

[44]Multilateral debt in newspaper articles are for the following countries: Cuba (1983-1985), Iraq (1986-2006), Poland (1981-1994) and all the former republics of Yugoslavia (1983-1988 and 1992-1997).

extend the dataset of Dreher and Gassebner (2012) by means on the IMF MONA database and the WB Projects & Operations listing.[45] The two aforementioned authors propose three variables. The first one is a dummy taking value one if the sovereign is under a IMF's Structural Adjustment Facility (SAF) or Poverty Reduction and Growth Facility (PRGF) program for at least five months. The second variable is also a dummy taking value one if the sovereign is under a IMF's Stand-by Agreement (SBA) program for at least five months. I merge those two dummies together under the label of IMF program. Finally, the two authors propose a variables counting the number of WB's loans given for structural adjustment in effect for at least five months. I label this variable as WB adjustment loan.

Regarding the IMF's and WB's charged interest rate, I retrieve the IMF adjusted rate of charge and the IDA service charge directly from the IMF's and the WB's websites. For the IBRD lending rate, I gather the historical data on 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%. Spreads are calculated as the rate charged minus 1-year US government bonds yield.

To control for the political situation of each sovereign I add two main sources of data. First, I use the database of Bjørnskov and Rode (2020) who propose a set of dummies to account for the type of and the change in political regimes. I would have liked to have a single variable controlling for the political risk. Unfortunately, the variables developed by Political Risk Services Group – which is the standard in the empirical literature and has the most comprehensive coverage – only starts in 1984 and does not cover all the countries in my sample. Finally I obtain dummies for the irruption of inter and intra-state wars using the database of Sarkees and Wayman (2010).

## C Regression Analysis

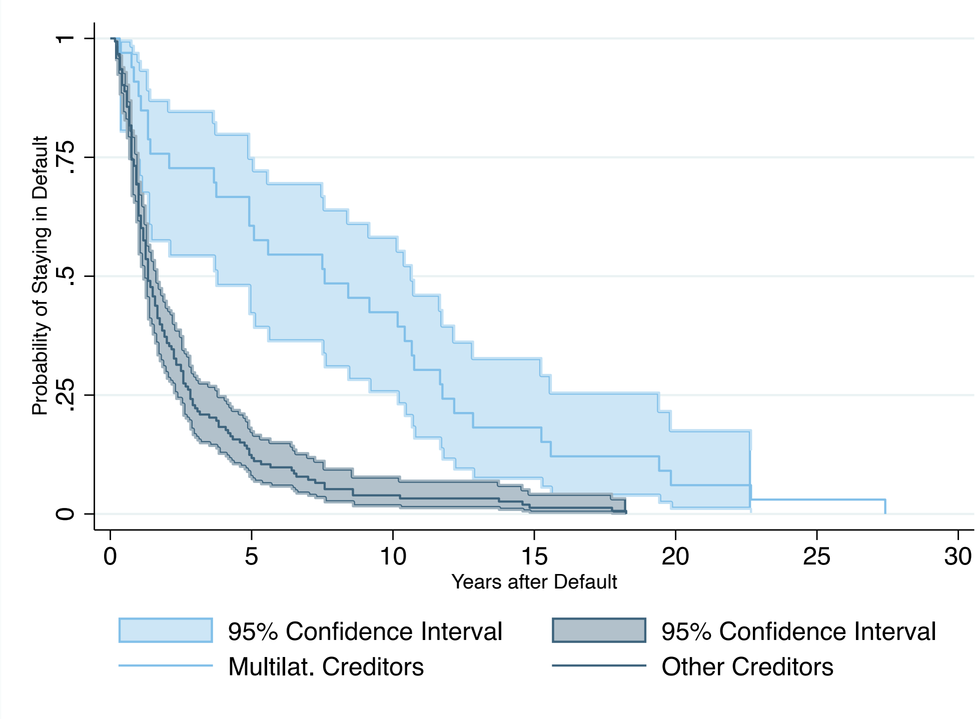
This section assesses the robustness of the empirical facts presented in Section 4. While Facts I and IV can be directly imputed to the multilateral creditors, Facts II and III might be associated to different factors.[46]

I start with Fact II and analyze the probability of remaining in default when defaulting on multilateral creditors. For this purpose, I conduct three analytical exercises. First, I estimate the survival function using a non-parametric estimator. Second, I conduct a cross-sectional analysis controlling for the default's and the country's specificities using an OLS estimator.

[45]Link to the WB Projects & Operations listing is available here.

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

Finally, I run a longitudinal analysis with similar control variables using a semi-parametric Cox proportional hazard model.




*Note*: Kaplan-Meyer estimates of the unconditional survival function.

Figure C.6: Non-Parametric Survival Function

The non-parametric estimate of the survival function is presented in Figure C.6. It indicates a lower probability of leaving the default's state in the case of default on multilateral creditors. Most notably, default episodes without multilateral creditors have a 75% probability of successfully exiting the default state within 3 to 4 years, while for defaults with multilateral creditors this same probability amounts roughly 25%.

It is entirely plausible that some other factors that are at the source of lengthy defaults also explain the default on multilateral debt. That is why I estimate both an OLS and a semi-parametric proportional hazard model. Both models treat the default duration as functions of the types of creditor involved in the default alongside a number of control variables. For the OLS regression, I estimate the following equation

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

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

I consider two specifications for the default duration to ensure the robustness of my analysis. On the one hand, I take the definition Asonuma and Trebesch (2016) (i.e. A&T) which accounts for the duration of individual restructurings. On the other hand, I follow the definition of Standard & Poor's (i.e. S&P) which often aggregates restructurings together (Beers and Chambers, 2006).

For the choice of control variables I follow the literature on the determinants of default.[47] More precisely, I account for three sets of control variables. The first one relates to the specificity of the default episode and includes the total amount of debt defaulted, a dummy variable taking value one in case of a Brady deal and the private creditors' SZ haircut.

The second set of controls accounts for the economic condition of the country in default. I first add the standard control variables such as the debt held at the IMF as a share of GDP, the debt held at the WB as a share of GDP, the real GDP growth, the real GDP per capita growth, the net export per GDP, the inflation rate and the US Federal Funds Rate. Furthermore, I account for the trade openness of the economy by the sum of exports and imports as a share of GDP. Drawing on Reinhart and Rogoff (2004), I generate a dummy for serial defaulters taking value one if the country defaulted more than twice in the period under study. Finally, I introduce a dummy to account for whether the country is eligible for the HIPC or IDA programs following Allen (2008). Once a country enters such program, it becomes qualified for some automatic debt relief and other concessional actions. In a similar logic, Reinhart and Trebesch (2016) show that defaults often overlap with an IMF program. I therefore include a dummy taking values 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 last set of control variables accounts for the political situation of the country under default. A default often coincides with a major political disruption or the outbreak of a war. Hence, I add a batterie of dummy variables accounting for such events. I control for the outbreak of inter and intra-state wars in the year of the default and the year preceding it using two dummies. For the political system, I add a set of dummy variables accounting for whether the defaulting country is a communist regime, whether it is a dictatorial regime, whether it changed to a dictatorial regime the year of the default or the year preceding it, whether there has been legislative elections or those elections have been postponed in the

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

year of the default or the year preceding it and whether there has been a coup in the year of the default or the year preceding it.[48]

Table C.3: OLS Duration Regressions

| | (1) A&T | (2) A&T | (3) A&T | (4) A&T | (5) A&T | (6) S&P | (7) S&P | (8) S&P | (9) S&P | (10) S&P |
|---|---|---|---|---|---|---|---|---|---|---|
| Multilateral Creditors | 5.32*** | 3.31*** | 2.90*** | 2.98*** | 3.18*** | 6.66*** | 4.53*** | 3.77** | 4.01** | 5.27*** |
| | [1.32] | [1.05] | [1.01] | [1.06] | [1.05] | [1.66] | [1.49] | [1.57] | [1.62] | [1.73] |
| Paris Club | 0.85 | -0.23 | -0.29 | 0.13 | 0.09 | -0.52 | -0.82 | -1.12 | -0.82 | -1.00 |
| | [0.58] | [0.54] | [0.54] | [0.53] | [0.60] | [1.73] | [1.58] | [1.47] | [1.41] | [1.35] |
| Other Official Creditors | 1.83*** | 0.25 | -0.12 | -0.25 | -0.41 | 4.32** | 1.65 | 1.34 | 1.27 | 1.75 |
| | [0.59] | [0.54] | [0.64] | [0.66] | [0.72] | [1.79] | [1.57] | [1.78] | [1.72] | [2.11] |
| Bank Loans | -1.22 | -3.09*** | -2.78** | -4.03*** | -4.16*** | -2.00 | -4.03** | -3.97* | -6.35*** | -6.77*** |
| | [0.85] | [1.12] | [1.09] | [1.33] | [1.46] | [1.86] | [1.86] | [2.05] | [2.13] | [2.06] |
| Bonds and Other Private Creditors | 0.27 | 0.88 | 1.12* | 1.27* | 1.33* | 1.19 | 0.41 | -0.14 | 0.91 | 0.86 |
| | [0.68] | [0.56] | [0.64] | [0.66] | [0.74] | [2.00] | [1.49] | [1.60] | [1.54] | [1.73] |
| Debt Restructured | | 0.00*** | 0.00** | 0.00 | 0.00* | | 0.00* | 0.00 | 0.00 | -0.00 |
| | | [0.00] | [0.00] | [0.00] | [0.00] | | [0.00] | [0.00] | [0.00] | [0.00] |
| SZ Haircut | | 0.08*** | 0.09*** | 0.10*** | 0.10*** | | 0.09*** | 0.11*** | 0.11*** | 0.11*** |
| | | [0.01] | [0.02] | [0.02] | [0.02] | | [0.02] | [0.03] | [0.03] | [0.03] |
| Brady Deal | | 2.79*** | 2.66*** | 2.45** | 2.19** | | 3.21** | 2.50* | 2.65* | 3.24* |
| | | [1.04] | [0.95] | [0.97] | [1.03] | | [1.46] | [1.36] | [1.57] | [1.68] |
| HIPC or IDA Eligibility | | | -1.62 | -0.95 | -0.57 | | | -0.86 | 0.96 | 0.76 |
| | | | [1.04] | [1.10] | [1.15] | | | [1.64] | [1.79] | [1.92] |
| Real GDP per Capita Growth, Start | | | -0.54 | -0.70* | -0.82** | | | -1.05* | -1.33** | -1.35** |
| | | | [0.36] | [0.37] | [0.36] | | | [0.57] | [0.65] | [0.59] |
| Real GDP Growth, Start | | | 0.50 | 0.69* | 0.83** | | | 0.92* | 1.22* | 1.31** |
| | | | [0.34] | [0.36] | [0.36] | | | [0.54] | [0.62] | [0.58] |
| Federal Fund Rate, Start | | | 1.69*** | 1.85*** | 1.77*** | | | 2.08** | 2.56*** | 1.93** |
| | | | [0.56] | [0.56] | [0.62] | | | [0.84] | [0.86] | [0.79] |
| Serial Defaulter | | | 0.73 | 1.04 | 0.98 | | | -1.64 | -0.93 | -1.46 |
| | | | [1.03] | [1.03] | [1.03] | | | [1.25] | [1.27] | [1.35] |
| Inflation, Start | | | 0.01 | 0.00 | 0.00 | | | 0.08* | 0.06 | 0.07 |
| | | | [0.02] | [0.02] | [0.02] | | | [0.04] | [0.04] | [0.04] |
| Trade Openness, Start | | | 0.02* | 0.02** | 0.02** | | | 0.02 | 0.02 | 0.02 |
| | | | [0.01] | [0.01] | [0.01] | | | [0.02] | [0.02] | [0.02] |
| Net Exports (% GDP), Start | | | 0.01 | 0.01 | 0.01 | | | 0.03 | 0.05 | 0.03 |
| | | | [0.02] | [0.02] | [0.02] | | | [0.03] | [0.04] | [0.04] |
| IMF Program, Start | | | | -1.49 | -2.01 | | | | -1.00 | -0.59 |
| | | | | [1.46] | [1.49] | | | | [1.12] | [1.24] |
| WB Adjustment loans, Start | | | | 0.07 | 0.08 | | | | -0.11 | -0.25 |
| | | | | [0.21] | [0.24] | | | | [0.34] | [0.35] |
| IMF Debt (% GDP), Start | | | | -0.03 | -0.03 | | | | 0.02 | -0.07 |
| | | | | [0.06] | [0.06] | | | | [0.10] | [0.10] |
| WB Debt (% GDP), Start | | | | -0.14** | -0.17** | | | | -0.29** | -0.34** |
| | | | | [0.06] | [0.07] | | | | [0.14] | [0.16] |
| Regime Change to Dictatorship, Start | | | | | -2.94 | | | | | -5.70 |
| | | | | | [2.30] | | | | | [3.99] |
| Dictatorial Regime, Start | | | | | -0.10 | | | | | 2.19 |
| | | | | | [0.68] | | | | | [1.39] |
| War, Start | | | | | 1.16 | | | | | 1.45 |
| | | | | | [1.20] | | | | | [1.76] |
| Civil War, Start | | | | | -2.42* | | | | | -0.02 |
| | | | | | [1.37] | | | | | [3.58] |
| Legislative Election, Start | | | | | -0.39 | | | | | 0.32 |
| | | | | | [0.61] | | | | | [1.48] |
| Postponed Legislative Election, Start | | | | | 2.77 | | | | | 5.32 |
| | | | | | [1.80] | | | | | [3.40] |
| Coup, Start | | | | | 0.65 | | | | | 2.16 |
| | | | | | [1.23] | | | | | [2.18] |
| Communist Regime, Start | | | | | -0.36 | | | | | -3.32 |
| | | | | | [1.03] | | | | | [2.60] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Region FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 187 | 187 | 187 | 187 | 187 | 104 | 104 | 104 | 104 | 104 |
| $R^2$ adjusted | 0.34 | 0.56 | 0.58 | 0.59 | 0.59 | 0.42 | 0.60 | 0.63 | 0.65 | 0.65 |

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

Finally, following Cruces and Trebesch (2013), I introduce year and region fixed effects. The latter accounts for the fact that defaults of Latin American countries have very different characteristics (including unobservables) compared to defaults in Europe or Asia. Conversely, the year fixed effects control for potential issues in the timing of restructuring as defaults often happen in waves (Reinhart and Rogoff, 2009).

[48] There is no transition to a communist regime in the sample at hand. I therefore do not include a dummy for that.

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

Regarding the control variables, there are some significant results. First and foremost, the SZ haircut is positively associated with the default's duration. This stark relationship is consistent with the findings of Benjamin and Wright (2013). Besides this, countries involved in a Brady deal record a longer default's duration. However, there is mixed evidence regarding WB adjustment loans and HIPC or IDA programs, while IMF programs are associated with shorter default duration. Interestingly, the WB debt is related to a reduced default length, while there is almost no effect associated with the IMF debt.

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. While the OLS specification relied on a cross-sectional structure of the data, the Cox model builds on longitudinal datasets. In other words, the latter can control for the evolution of the economic and political variables throughout the default's duration. More precisely, 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. That is, the dependent variable is a dummy taking value 1 if the country exits the default and zero otherwise. 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.

In terms of controls, I use the same sort of 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 other variables that are not time-varying are: the creditor's dummies, the HIPC or IDA eligibility and the SZ haircut. Note that the political dummies referring to legislative elections, postponed elections and coups take value one in the year of occurrence of such event and the year preceding it and zero otherwise. Finally, similar to the previous set of regressions, I introduce year and region fixed effects.

Table C.4: Cox Duration Regressions

| | (1)<br>A&T | (2)<br>A&T | (3)<br>A&T | (4)<br>A&T | (5)<br>A&T | (6)<br>S&P | (7)<br>S&P | (8)<br>S&P | (9)<br>S&P | (10)<br>S&P |
|---|---|---|---|---|---|---|---|---|---|---|
| Multilateral Creditors | 0.37*** | 0.52*** | 0.63** | 0.63** | 0.64* | 0.31*** | 0.39*** | 0.42*** | 0.43*** | 0.40*** |
| | [0.20] | [0.21] | [0.21] | [0.22] | [0.23] | [0.24] | [0.26] | [0.27] | [0.30] | [0.33] |
| Paris Club | 0.82 | 0.94 | 0.95 | 0.81 | 0.82 | 0.65* | 0.69 | 0.68 | 0.68 | 0.72 |
| | [0.17] | [0.17] | [0.19] | [0.20] | [0.20] | [0.26] | [0.28] | [0.29] | [0.31] | [0.32] |
| Other Official Creditors | 0.69** | 0.93 | 1.05 | 1.08 | 1.08 | 0.67 | 0.85 | 0.78 | 0.88 | 0.90 |
| | [0.19] | [0.23] | [0.25] | [0.23] | [0.24] | [0.32] | [0.38] | [0.43] | [0.41] | [0.43] |
| Bank Loans | 1.23 | 2.21** | 2.56** | 2.56** | 2.67*** | 1.03 | 1.54 | 1.47 | 1.85 | 1.93 |
| | [0.30] | [0.37] | [0.40] | [0.39] | [0.36] | [0.35] | [0.43] | [0.43] | [0.46] | [0.44] |
| Bonds and Other Private Creditors | 0.89 | 0.89 | 0.85 | 0.81 | 0.80 | 0.49*** | 0.71 | 0.89 | 0.66 | 0.57 |
| | [0.16] | [0.18] | [0.17] | [0.16] | [0.17] | [0.27] | [0.31] | [0.34] | [0.33] | [0.36] |
| SZ Haircut | | 0.98*** | 0.97*** | 0.97*** | 0.97*** | | 0.98*** | 0.98*** | 0.97*** | 0.97*** |
| | | [0.00] | [0.00] | [0.00] | [0.00] | | [0.00] | [0.01] | [0.01] | [0.01] |
| Debt Restructured | | 1.00 | 1.00** | 1.00*** | 1.00** | | 1.00 | 1.00 | 1.00 | 1.00 |
| | | [0.00] | [0.00] | [0.00] | [0.00] | | [0.00] | [0.00] | [0.00] | [0.00] |
| Brady Deal | | 0.72 | 0.73 | 0.70 | 0.69 | | 0.52** | 0.48*** | 0.44*** | 0.45*** |
| | | [0.26] | [0.24] | [0.25] | [0.26] | | [0.30] | [0.27] | [0.30] | [0.31] |
| HIPC or IDA Eligibility | | | 0.91 | 0.89 | 0.81 | | | 0.71 | 0.48* | 0.54 |
| | | | [0.25] | [0.29] | [0.30] | | | [0.30] | [0.38] | [0.42] |
| Serial Defaulter | | | 1.08 | 1.19 | 1.16 | | | 1.11 | 1.08 | 1.11 |
| | | | [0.23] | [0.23] | [0.24] | | | [0.27] | [0.27] | [0.28] |
| Federal Funds Rate | | | 0.01*** | 0.01*** | 0.01*** | | | 0.01*** | 0.01*** | 0.01*** |
| | | | [0.06] | [0.06] | [0.07] | | | [0.07] | [0.08] | [0.09] |
| Real GDP per Capita Growth | | | 1.03 | 1.02 | 1.03 | | | 1.01 | 0.97 | 0.97 |
| | | | [0.04] | [0.04] | [0.04] | | | [0.06] | [0.06] | [0.07] |
| Real GDP Growth | | | 0.98 | 0.98 | 0.98 | | | 0.99 | 1.02 | 1.02 |
| | | | [0.04] | [0.04] | [0.04] | | | [0.06] | [0.06] | [0.07] |
| Net Exports (% GDP) | | | 0.99 | 0.99 | 0.99 | | | 0.99* | 0.99* | 0.99 |
| | | | [0.00] | [0.00] | [0.01] | | | [0.01] | [0.01] | [0.01] |
| Inflation | | | 1.00 | 1.00 | 1.00 | | | 1.00 | 1.00 | 1.00 |
| | | | [0.00] | [0.00] | [0.00] | | | [0.01] | [0.01] | [0.01] |
| Trade Openness | | | 0.38*** | 0.31*** | 0.31*** | | | 0.54** | 0.54** | 0.54** |
| | | | [0.27] | [0.32] | [0.33] | | | [0.31] | [0.32] | [0.31] |
| IMF Program | | | | 1.54*** | 1.58*** | | | | 2.29*** | 2.33*** |
| | | | | [0.14] | [0.15] | | | | [0.25] | [0.27] |
| WB Adjustment loans | | | | 1.04 | 1.05 | | | | 1.05 | 1.05 |
| | | | | [0.05] | [0.05] | | | | [0.05] | [0.05] |
| IMF Debt (% GDP), Start | | | | 1.03** | 1.03** | | | | 1.03* | 1.03* |
| | | | | [0.01] | [0.01] | | | | [0.02] | [0.02] |
| WB Debt (% GDP), Start | | | | 0.99 | 0.99 | | | | 0.99 | 0.98 |
| | | | | [0.02] | [0.02] | | | | [0.02] | [0.03] |
| IMF Debt (% GDP), End | | | | 1.00 | 1.00 | | | | 1.01 | 1.01 |
| | | | | [0.01] | [0.01] | | | | [0.01] | [0.01] |
| WB Debt (% GDP), End | | | | 1.00 | 1.00 | | | | 1.02 | 1.03 |
| | | | | [0.01] | [0.01] | | | | [0.02] | [0.02] |
| Coup | | | | | 1.30 | | | | | 1.67 |
| | | | | | [0.32] | | | | | [0.61] |
| Communist Regime | | | | | 1.21 | | | | | 1.21 |
| | | | | | [0.24] | | | | | [0.46] |
| Dictatorial Regime | | | | | 1.08 | | | | | 0.97 |
| | | | | | [0.19] | | | | | [0.33] |
| Postponed Legislative Election | | | | | 0.83 | | | | | 1.21 |
| | | | | | [0.57] | | | | | [0.83] |
| Legislative Election | | | | | 0.83 | | | | | 1.10 |
| | | | | | [0.14] | | | | | [0.21] |
| War | | | | | 0.77 | | | | | 2.25 |
| | | | | | [0.74] | | | | | [0.70] |
| Civil War | | | | | 1.04 | | | | | 0.77 |
| | | | | | [0.22] | | | | | [0.35] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Region FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 654 | 654 | 654 | 654 | 654 | 670 | 670 | 670 | 670 | 670 |
| Episodes | 160 | 160 | 160 | 160 | 160 | 98 | 98 | 98 | 98 | 98 |
| Pseudo $R^2$ | 0.06 | 0.09 | 0.09 | 0.10 | 0.10 | 0.15 | 0.16 | 0.17 | 0.19 | 0.19 |

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

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.

The outcome of the Cox duration regressions is depicted in Table C.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 creditors is related to a longer default. More precisely, such event is associated with a reduced probability of exiting default between 36% and 69% depending on the model's specification. Moreover, defaults involving the Paris Club and other official creditors seem to reduce the probability of exiting default, but the coefficients lack robustness. Regarding private creditors, it seems that defaults on bank loans are settled more quickly. However, the magnitude and the statistical significance of the coefficients vary a great deal across the different specifications.

Regarding the control variables, greater haircuts are associated with a reduced probability of exiting the default state. The same holds true for the HIPC or IDA eligibility and Brady deals. The IMF debt is associated to an increasing probability of ending default – at least at the default's start – while there is little effects related to the WB debt. Finally, the participation to both an IMF program or a WB adjustment loan are associated to an increasing probability of ending default. Only the former is economically and statistically significant, though.

In view of the results presented above, it seems that Fact II 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 length and multilateral creditors.

I now assess the robustness of Fact III. The aim is to gauge whether greater private creditors' losses are due to the presence of multilateral lenders or are simply a by-product of other factors. For this purpose, I conduct OLS regressions with similar controls and fixed effects as before. The equation, I estimate is the following

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

where $i$ refers to a specific restructuring episode, $H_i^k$ is the haircut's specification of $k \in \{M, SZ\}$ defined below and the remaining variable is the error term, $u_i$.

I consider two specifications of the haircut. The first one is the market haircut, $H^M$, and is the one computed by rating agencies and official lenders. It however tends to overestimate the level of creditor's losses. That is why I consider a second haircut specification based on the estimation method of Sturzenegger and Zettelmeyer (2008), $H^{SZ}$.

Table C.5: Haircut Regressions

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $H^M$ | $H^M$ | $H^M$ | $H^M$ | $H^M$ | $H^{SZ}$ | $H^{SZ}$ | $H^{SZ}$ | $H^{SZ}$ | $H^{SZ}$ |
| Multilateral Creditors | 15.19*** | 9.13* | 9.05** | 9.07* | 9.60* | 15.25*** | 7.97 | 7.68* | 8.18* | 8.93* |
| | [5.27] | [5.48] | [4.36] | [4.64] | [4.89] | [5.38] | [5.29] | [4.27] | [4.41] | [4.62] |
| Paris Club | 8.37** | 7.49* | 7.97*** | 5.98** | 5.71** | 7.74* | 6.89* | 7.56** | 5.66* | 5.29* |
| | [4.04] | [3.97] | [3.04] | [2.84] | [2.84] | [4.09] | [3.90] | [3.09] | [2.97] | [2.91] |
| Other Official Creditors | 9.26** | 9.06* | 10.15** | 9.86** | 11.83*** | 7.93* | 7.82* | 8.71* | 8.20* | 10.59** |
| | [4.64] | [4.79] | [4.55] | [4.15] | [4.32] | [4.62] | [4.70] | [4.59] | [4.22] | [4.49] |
| Bank Loans | 21.53** | 13.48 | 4.27 | 14.14* | 15.56** | 25.01*** | 14.94* | 6.07 | 16.18** | 18.02** |
| | [8.50] | [8.25] | [8.30] | [7.17] | [7.21] | [8.54] | [8.61] | [8.32] | [7.46] | [7.61] |
| Bonds and Other Private Creditors | -10.02** | -10.53** | -11.41*** | -10.94*** | -11.09*** | -8.54* | -9.15** | -9.83** | -9.36** | -9.46** |
| | [4.46] | [4.62] | [4.29] | [4.12] | [4.22] | [4.63] | [4.61] | [4.42] | [4.43] | [4.54] |
| Private Debt Restructured | | 0.00 | 0.00 | 0.00* | 0.00** | | 0.00 | 0.00 | 0.00 | 0.00* |
| | | [0.00] | [0.00] | [0.00] | [0.00] | | [0.00] | [0.00] | [0.00] | [0.00] |
| Default Duration | | 1.74*** | 1.35*** | 1.17** | 1.04** | | 2.06*** | 1.70*** | 1.54*** | 1.38*** |
| | | [0.64] | [0.49] | [0.47] | [0.51] | | [0.66] | [0.52] | [0.48] | [0.52] |
| Brady Deal | | -9.85 | -4.81 | 4.93 | 3.83 | | -15.96** | -10.94* | -1.27 | -2.78 |
| | | [6.92] | [5.40] | [4.96] | [5.17] | | [7.19] | [6.09] | [5.77] | [6.06] |
| HIPC or IDA Eligibility | | | 26.54*** | 16.53*** | 13.99** | | | 24.74*** | 14.41*** | 11.45** |
| | | | [5.10] | [5.05] | [5.50] | | | [5.30] | [5.35] | [5.69] |
| Serial Defaulter | | | 8.45 | 5.38 | 3.96 | | | 9.30* | 6.80 | 5.21 |
| | | | [5.23] | [5.04] | [5.28] | | | [5.55] | [5.41] | [5.67] |
| Federal Funds Rate, End | | | -6.32*** | -8.41*** | -8.01*** | | | -7.06*** | -9.00*** | -8.44*** |
| | | | [1.80] | [1.71] | [1.82] | | | [1.81] | [1.83] | [1.89] |
| Real GDP Growth, End | | | -4.71** | -4.88** | -4.70** | | | -4.77** | -5.12** | -4.86** |
| | | | [1.90] | [1.92] | [1.95] | | | [1.96] | [1.97] | [2.00] |
| Real GDP per Capita Growth, End | | | 5.36*** | 5.43*** | 5.27*** | | | 5.42*** | 5.67*** | 5.44*** |
| | | | [1.88] | [1.92] | [1.92] | | | [1.94] | [1.96] | [1.96] |
| Net Exports (% GDP), End | | | -0.11 | -0.04 | -0.06 | | | -0.13 | -0.06 | -0.08 |
| | | | [0.12] | [0.10] | [0.10] | | | [0.12] | [0.10] | [0.10] |
| Inflation, End | | | 0.19** | 0.15* | 0.17** | | | 0.18** | 0.14 | 0.17* |
| | | | [0.08] | [0.08] | [0.09] | | | [0.08] | [0.09] | [0.09] |
| Trade Openness, End | | | -0.16*** | -0.16*** | -0.15*** | | | -0.14** | -0.12*** | -0.12** |
| | | | [0.05] | [0.04] | [0.05] | | | [0.05] | [0.05] | [0.05] |
| IMF Program, End | | | | 0.35 | 1.09 | | | | 0.49 | 1.32 |
| | | | | [2.83] | [2.85] | | | | [3.05] | [3.08] |
| WB Adjustment loans, End | | | | -1.50* | -1.53* | | | | -1.05 | -1.08 |
| | | | | [0.90] | [0.88] | | | | [0.97] | [0.94] |
| IMF Debt (% GDP), End | | | | -0.32* | -0.27 | | | | -0.44*** | -0.39** |
| | | | | [0.16] | [0.19] | | | | [0.16] | [0.19] |
| WB Debt (% GDP), End | | | | 1.40*** | 1.40*** | | | | 1.44*** | 1.42*** |
| | | | | [0.23] | [0.24] | | | | [0.25] | [0.25] |
| Communist Regime, End | | | | | 2.73 | | | | | 3.53 |
| | | | | | [4.99] | | | | | [5.71] |
| Dictatorial Regime, End | | | | | 2.25 | | | | | 2.40 |
| | | | | | [3.69] | | | | | [3.75] |
| Legislative Election, End | | | | | -3.51 | | | | | -4.55 |
| | | | | | [3.10] | | | | | [3.19] |
| Postponed Legislative Election, End | | | | | -4.58 | | | | | -2.26 |
| | | | | | [7.20] | | | | | [8.40] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Region FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 187 | 187 | 187 | 187 | 187 | 187 | 187 | 187 | 187 | 187 |
| $R^2$ adjusted | 0.46 | 0.50 | 0.64 | 0.70 | 0.70 | 0.44 | 0.49 | 0.61 | 0.68 | 0.68 |

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

In terms of controls, I add similar variables as for the previously exposed regressions. First, I control for the default's specificity by including the amount of private debt the country defaulted on, a dummy for the presence of a Brady deal and the default's duration in year. Second, I control for the economic situation of the country at the default's end using the same control variables as for the OLS duration regressions. Furthermore, I account for the political system of the economy at the moment of the restructuring. More precisely, I add a dummy controlling whether the country is a communist or a dictatorial regime as well as two dummies to control for legislative elections and postponed legislative elections in the year of the restructuring or the year preceding it. Finally, in accordance to what has been done previously, I introduce year and region fixed effects.

Table C.5 presents the results of the haircut regressions. The coefficient related to multilateral defaults is economically important. Defaulting on multilateral creditors is associated with an increase of the private creditors' haircut between 8 and 15 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 creditors are also associated with larger haircuts. The same holds true for the other official creditors with a greater economic and statistical significance than for multilateral creditors. Regarding private creditors, defaults on bonds and other private creditors are associated with lower haircuts, while the opposite holds true for bank loans.

Regarding the control variables, one observes many significant results. Especially, the duration has a a strong and positive association with the private haircut. Once added to the regression, the effect attributed to the multilateral lenders decreases. Similarly, the HIPC or IDA eligibility have a strong and positive association with the private haircut. This was to be expected as such programs automatically provide substantial debt reliefs. Besides this, the coefficients attached to the real GDP growth, the Federal Funds Rate and the trade openness are strongly and negatively associated with the private haircut. This indicates that better recovery of the economy tend to be associated with lower haircuts. Finally, the level of WB debt to GDP is positively associated with the haircut, while the opposite is true for the level of IMF debt to GDP. Note however that neither an IMF program nor a WB adjustment loan seem to significantly affect the haircut.

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

# D Competitive Equilibrium

In this section, I define the competitive equilibrium. On the sovereign's side, the equilibrium is composed of two components. First, given the prices and the outcome of the renegotiation problem, the sovereign determines its repayment decision. Second, given the prices and the outcome of the repayment problem, the sovereign sets its restructuring decision. On the lenders' side, the equilibrium is governed by the break even assumption.

**Definition D.1** (Recursive Equilibrium)**.** *A recursive equilibrium in this environment consists of*

- *Policy functions for the sovereign's consumption,* $c(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$*, private bond holdings,* $b_p(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$*, multilateral bond holdings,* $b_m(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$*, default,* $D^{DP}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ *and*

$D^{DF}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, *proposed settlement,* $W^{RP}_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ *and* $W^{RF}_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, *and stopping functions,* $A^{DP}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p, W)$ *and* $A^{DF}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p, W)$.

- *Policy functions for the lenders' proposed settlement,* $W^{RP}_l(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ *and* $W^{RF}_l(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$.
- *Price schedules for the multilateral debt,* $q_m(z, b^i_m, b^i_p)$, *and the private debt,* $q_p(z, b^i_m, b^i_p)$.

*such that*

1. *Taking the above prices as given,*
   (a) *and taking the solution to the renegotiation problem as given, the policy functions* $c(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $b_p(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $b_m(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $D^{DP}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ *and* $D^{DF}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ *solve the sovereign's repayment problem in (1)-(4).*
   (b) *and taking the solution to the repayment problem as given, the policy functions* $W^{RP}_l(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $W^{RP}_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $W^{RF}_l(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $W^{RF}_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$, $A^{DP}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p, W)$ *and* $A^{DF}(z, \boldsymbol{\epsilon}, b^i_m, b^i_p, W)$ *solve the sovereign's renegotiation problem in (5)-(9).*
2. *The price charged by the private and multilateral lenders correctly reflects the default probability and the expected recovery rate and is consistent with zero expected profit.*

# E 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 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

$$\begin{aligned} V(z, b^i_m, b^i_p) =& \omega \ln \Bigg\{ \Bigg( \sum_{j=1}^{\mathcal{J}} \exp(u(c_{i,j}(z)) + \beta \mathbb{E}_{z'|z} V(z', b^j_m, b^j_p))^{\frac{1}{\omega\nu}} \Bigg)^{\nu} \\ &+ \Bigg( \exp(u(y^{DP}(z) + (1-\delta+\delta\kappa) b^i_m) + \beta \mathbb{E}_{z'|z} V^{RP}(z', \delta b^i_m, b^i_p)) \Bigg)^{\frac{1}{\omega}} \\ &+ \Bigg( \exp(u(y^{DF}(z)) + \beta \mathbb{E}_{z'|z} V^{RF}(z', b^i_m, b^i_p)) \Bigg)^{\frac{1}{\omega}} \Bigg\} \\ \text{s.t. } c_{i,j}(z) =& y(z) + [1-\delta+\delta\kappa]\,(b^i_m + b^i_p) - q_m(z, b^j_m, b^j_p)(b^j_m - \delta b^i_m) - q_p(z, b^j_m, b^j_p)(b^j_p - \delta b^i_p). \end{aligned} \tag{E.1}$$

The probability of choosing the portfolio $\{b_m^j, b_p^j\}$ is then given by

$$B(b_m^j, b_p^j; z, b_m^i, b_p^i) = \frac{\exp\left(u(c_{i,j}(z)) + \beta\mathbb{E}_{z'|z}V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}}{\sum_{k=1}^{\mathcal{J}} \exp\left(u(c_{i,k}(z)) + \beta\mathbb{E}_{z'|z}V(z', b_m^k, b_p^k)\right)^{\frac{1}{\omega\nu}}}. \tag{E.2}$$

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

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

where

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

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

$$\begin{aligned} V^{RP}(z, b_m^i, b_p^i) =& \omega\phi \ln\Bigg\{\Bigg(\sum_{j,\tau_j\geq 0, b_m^j=\delta b_m^i} \exp\left(u(c_{i,j}(z, W_l^{RP}) + \beta\mathbb{E}_{z'|z}V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}\Bigg)^{\nu} \\ &+ \exp\left(u(y^{DP}(z) + (1-\delta+\delta\kappa)b_m^i) + \beta\mathbb{E}_{z'|z}V^{RP}(z', \delta b_m^i, b_p^i)\right)^{\frac{1}{\omega}}\Bigg\} \\ &+ \omega(1-\phi)\ln\Bigg\{\Bigg(\sum_{j,\tau_j\geq 0, b_m^j=\delta b_m^i} \exp\left(u(c_{i,j}(z, W_b^{RP}) + \beta\mathbb{E}_{z'|z}V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}\Bigg)^{\nu} \\ &+ \exp\left(u(y^{DP}(z) + (1-\delta+\delta\kappa)b_m^i) + \beta\mathbb{E}_{z'|z}V^{RP}(z', \delta b_m^i, b_p^i)\right)^{\frac{1}{\omega}}\Bigg\} \\ &\text{s.t. } c_{i,j}(z, W) = y(z) + [1-\delta+\delta\kappa]\, b_m^i - W - q_p(z, b_m^j, b_p^j) b_p^j. \end{aligned} \tag{E.3}$$

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

$$A^{RP}(z, b_m^i, b_p^i, W_k^{RP}) = \frac{\left(\sum_{j,\tau_j \geq 0, b_m^j = \delta b_m^i} \exp\left(u(c_{i,j}(z, W_k^{RP}) + \beta \mathbb{E}_{z'|z} V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}\right)^{\nu}}{\left(\sum_{j,\tau_j \geq 0, b_m^j = \delta b_m^i} \exp\left(u(c_{i,j}(z, W_k^{RP}) + \beta \mathbb{E}_{z'|z} V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}\right)^{\nu} + \mathcal{X}(z, b_m^i, b_p^i)}.$$

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

$$\begin{aligned} V^{RF}(z, b_m^i, b_p^i) =& \omega\phi \ln \Bigg\{ \Bigg( \sum_{j,\tau_j \geq 0, b_m^j = 0} \exp\left(u(c_{i,j}(z, W_l^{RF}) + \beta \mathbb{E}_{z'|z} V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}} \Bigg)^{\nu} \\ & + \exp\left(u(y^{DF}(z)) + \beta \mathbb{E}_{z'|z} V^{RF}(z', b_m^i, b_p^i)\right)^{\frac{1}{\omega}} \Bigg\} \\ & + \omega(1-\phi) \ln \Bigg\{ \Bigg( \sum_{j,\tau_j \geq 0, b_m^j 0} \exp\left(u(c_{i,j}(z, W_b^{RF}) + \beta \mathbb{E}_{z'|z} V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}} \Bigg)^{\nu} \\ & + \exp\left(u(y^{DF}(z)) + \beta \mathbb{E}_{z'|z} V^{RF}(z', b_m^i, b_p^i)\right)^{\frac{1}{\omega}} \Bigg\} \\ & \text{s.t. } c_{i,j}(z, W) = y(z) + b_m^i \bar{q} - W - q_p(z, b_m^j, b_p^j) b_p^j. \end{aligned} \tag{E.4}$$

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

$$A^{RF}(z, b_m^i, b_p^i, W_k^{RF}) = \frac{\left(\sum_{j,\tau_j \geq 0, b_m^j = 0} \exp\left(u(c_{i,j}(z, W_k^{RF}) + \beta \mathbb{E}_{z'|z} V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}\right)^{\nu}}{\left(\sum_{j,\tau_j \geq 0, b_m^j = 0} \exp\left(u(c_{i,j}(z, W_k^{RF}) + \beta \mathbb{E}_{z'|z} V(z', b_m^j, b_p^j)\right)^{\frac{1}{\omega\nu}}\right)^{\nu} + \mathcal{Y}(z, b_m^i, b_p^i)}.$$

The private bond price therefore reduces to

$$\begin{aligned} q_p(z, b_m^j, b_p^j) = \frac{1}{1+r} \mathbb{E}_{z'|z} \Bigg[ & \left(1 - D^{DP}(z', b_m^j, b_p^j) - D^{DF}(z', b_m^j, b_p^j)\right) \times \\ & \left(1 - \delta + \delta\kappa + \delta \sum_{k=1}^{\mathcal{J}} q_p(z', b_m^k, b_p^k) B(b_m^k, b_p^k; z', b_m^j, b_p^j)\right) + \\ & D^{DP}(z', b_m^j, b_p^j) q_p^{DP}(z', b_m^j, b_p^j) + D^{DF}(z', b_m^j, b_p^j) q_p^{DF}(z', b_m^j, b_p^j) \Bigg]. \end{aligned} \tag{E.5}$$

with recovery value

$$q_p^{DP}(z, b_m^i, b_p^i) = \frac{1}{1+r}\mathbb{E}_{z'|z}\big[(1 - \phi A^{RP}(z', \delta b_m^i, b_p^i, W_l^{RP}))q_p^{DP}(z', \delta b_m^i, b_p^i) + \phi A^{RP}(z', \delta b_m^i, b_p^i, W_l^{RP})\frac{W_l^{RP}(z', \delta b_m^i, b_p^i)}{-b_p^i \bar{q}}\big],$$

and

$$q_p^{DF}(z, b_m^i, b_p^i) = \frac{1}{1+r}\mathbb{E}_{z'|z}\big[(1 - \phi A^{RF}(z', b_m^i, b_p^i, W_l^{RF}))q_p^{DF}(z', b_m^i, b_p^i) + \phi A^{RF}(z', b_m^i, b_p^i, W_l^{RF})\frac{W_l^{RF}(z', b_m^i, b_p^i)}{-b_p^i \bar{q}}\big].$$

Conversely, the multilateral debt price reduces to

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

with recovery value

$$q_m^{DF}(z, b_m^i, b_p^i) = \frac{1}{1+r}\mathbb{E}_{z'|z}\big[(1 - A^{RF}(z', b_m^i, b_p^i, W_l^{RF}))q_m^{DF}(z', b_m^i, b_p^i) + A^{RF}(z', \delta b_m^i, b_p^i, W_l^{RF})\bar{q}\big].$$

I solve the model using value function iterations on a discretized grid for output, private and multilateral debts. Following Hatchondo et al. (2010), both the value functions and the prices are iterated in the same loop.

The process starts with a guess of the value function $V$ as well as of the prices $q_p$ and $q_m$ corresponding to the limit of finite horizon. Given those guesses, I first determine the repayment value given by (2). I compute the value for each combination of multilateral and private debts. I also compute the bond choice probability through (E.2).

For the autarky values (3)-(4), 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 given in (7) and (9) by means of a grid search.[49] I subsequently generate the values of renegotiation using

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

(E.3)-(E.4) and compute the different sovereign's acceptance probabilities.

Having calculated the value under repayment and the value under default, I retrieve the new value of $V$ from equation (E.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 $q_p$ and $q_m$ by means of equations (E.5) and (E.6), respectively.

Subsequently, I compare the initial guesses with the new outcome. I compute the maximal absolute distance between the newly-computed and previously-computed prices of private and multilateral debts. The same is done for the value $V$. 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. The model-generated moments are computed as averages across countries. Business cycle moments are HP filtered with a smoothing parameter of 6.25.

## F Sensitivity to Utility Shocks

The utility shocks ease the numerical computation of the model. In fact without such shocks, I cannot always solve the model using standard value function iteration. It is possible to obtain some convergence under the refinement suggested by Chatterjee and Eyigungor (2012) but not for all specifications of the model.

Nevertheless, utility shocks are likely to affect the solution of the model. Especially, as shown by Dvorkin et al. (2021), they mainly affect the choices regarding debt and default. That is why I calibrated the variance parameter $\omega$ and the correlation parameter $\nu$ to the standard deviation debt-to-GDP ratio and the default duration, respectively.

As one can see in Table F.6, changes in $\omega$ and $\nu$ affect the main moments of the model in a negligible manner. Most notably, the variance parameter seems to affect the default duration and the debt dynamic. Conversely, the correlation parameter affects the duration and the default dynamic. The share of *full* default seems also to be sensitive to changes in both $\omega$ and $\nu$.

## G Maturity Differential

The benchmark model assumes that the same maturity for the private and the multilateral debt. I now relax this assumption and consider that the multilateral debt has a maturity $\delta_m$, while the private debt has a maturity $\delta_p$. In particular, I consider two settings: $\delta_m =$

Table F.6: Sensitivity to $\omega$ and $\nu$

| | Baseline | $\omega \times 0.70$ | $\omega \times 1.12$ | $\nu \times 0.85$ | $\nu \times 1.1$ |
|---|---|---|---|---|---|
| Default length (year)<br>(with multilateral lenders) | 5.0 | 5.3 | 4.8 | 5.0 | 4.9 |
| Default length (year)<br>(without multilateral lenders) | 3.1 | 2.9 | 2.7 | 2.7 | 2.7 |
| Private creditors' haircut (%)<br>(with multilateral lenders) | 49.3 | 55.8 | 47.6 | 52.4 | 48.1 |
| Private creditors' haircut (%)<br>(without multilateral lenders) | 32.1 | 36.0 | 31.8 | 34.1 | 31.8 |
| Debt-to-GDP ratio (%) | 40.8 | 39.1 | 41.2 | 40.1 | 41.4 |
| Multilateral-debt-to-GDP ratio (%) | 6.3 | 6.7 | 6.2 | 6.5 | 6.2 |
| Share *full* default (%) | 18.5 | 27.0 | 21.2 | 23.2 | 18.4 |
| Default rate (%) | 2.5 | 2.2 | 2.6 | 2.4 | 2.6 |
| Debt increase prior to default (percentage point) | 26.8 | 31.0 | 27.6 | 29.6 | 27.2 |
| Standard deviation debt-to-GDP ratio | 9.8 | 9.7 | 10.1 | 9.9 | 10.1 |
| Standard deviation duration | 3.4 | 3.8 | 3.5 | 3.6 | 3.4 |

$0.89 < 0.9 = \delta_p$ and $\delta_m = 0.9 < 0.91 = \delta_p$. I find that the model is very sensitive to such changes.

Allowing for a shorter maturity of the multilateral debt has two opposite consequence. On the one hans, as argued in Section 6, when $\delta_m \to 0$, a *partial* default becomes less attractive because the multilateral debt service is greater in the first few periods spent in autarky. Especially, when $\delta_m = 0$, the multilateral debt has to be repaid in one instalment at the beginning of the *partial* default. On the other hand, as argued by Arellano and Ramanarayanan (2012) and Niepelt (2014), shorter maturity enhances the willingness to repay and therefore can reduce the share of *full* defaults. As depicted in Table G.7, this second channel dominates as the share of *full* default decreases but the default rate increases.

Allowing for a longer maturity of the private debt reinforces the seniority cost to the repayment incentive. On the other hand, longer maturities are more sensitive to the default risk. On the other hand, more multilateral debt continues to depress the recovery value under a *full* default because of subordination. As one can see, when I set $\delta_p = 0.91$, the share of *full* default gets close to 100%. This is the opposite of when I reduce $\delta_m$.

Table G.7: Maturity Differential

| | Benchmark | $\delta_s = 0.89$ | $\delta_p = 0.91$ |
|---|---|---|---|
| Default length (year) (with multilateral lenders) | 4.95 | 5.12 | 6.12 |
| Default length (year) (without multilateral lenders) | 2.68 | 2.70 | 2.44 |
| Private creditors' haircut (%) (with multilateral lenders) | 49.34 | 46.58 | 57.50 |
| Private creditors' haircut (%) (without multilateral lenders) | 32.14 | 30.54 | 31.80 |
| Share *full* default (%) | 18.52 | 16.17 | 98.17 |
| Default rate (%) | 2.46 | 2.49 | 2.32 |
| Total debt increase (percentage point) (prior to default) | 26.84 | 25.58 | 53.30 |
| Total debt to GDP (%) | 40.77 | 41.15 | 43.91 |
| Multilateral debt to GDP (%) | 6.27 | 6.24 | 6.79 |
| Private debt spread (%) | 1.17 | 1.10 | 2.00 |
| Multilateral debt spread (%) | 0.44 | 0.43 | 0.76 |

# H Welfare Analysis

In this section, I present how welfare gains are calculated. To compute the sovereign's welfare, first define the value of the sovereign for a sequence of consumption $\{c(z^t, \boldsymbol{\epsilon}^t)\}$ starting from an initial state at $t = 0$ as

$$V(\{c(z^t, \boldsymbol{\epsilon}^t)\}) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(c(z^t, \boldsymbol{\epsilon}^t)) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c(z^t, \boldsymbol{\epsilon}^t)^{1-\varrho}}{1-\varrho},$$

where the last equality is obtained from the functional form considered in Section 9. I denote the sovereign's consumption allocation in the benchmark model by $\{c^b(z^t, \boldsymbol{\epsilon}^t)\}$ and the consumption allocation in the alternative model by $\{c^a(z^t, \boldsymbol{\epsilon}^t)\}$. The sovereign's value in the benchmark model in state $(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ is given by

$$V_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p) \equiv V(\{c^b(z^t, \boldsymbol{\epsilon}^t)\}).$$

Conversely, the sovereign's value under the alternative model in the exact same state $(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)$ reads

$$V_a(z, \boldsymbol{\epsilon}, b^i_m, b^i_p) \equiv V(\{c^a(z^t, \boldsymbol{\epsilon}^t)\}).$$

Now define the consumption-equivalent welfare gain of the alternative model with respect to the benchmark model by $\chi$ such that

$$V(\{(1+\chi)c^b(z^t, \boldsymbol{\epsilon}^t)\}) = V(\{c^a(z^t, \boldsymbol{\epsilon}^t)\}).$$

Given the functional form of the instantaneous utility one obtains

$$(1+\chi)^{1-\varrho} V_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p) = V_a(z, \boldsymbol{\epsilon}, b^i_m, b^i_p).$$

The welfare gain therefore boils down to

$$\chi(z, \boldsymbol{\epsilon}, b^i_m, b^i_p) = \left[\frac{V_a(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)}{V_b(z, \boldsymbol{\epsilon}, b^i_m, b^i_p)}\right]^{\frac{1}{1-\varrho}} - 1.$$