Beyond Market Exclusion: Creditor Attrition After Sovereign Default

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Abstract

Sovereign defaults are conventionally believed to trigger outright exclusion from international capital markets. We challenge this notion using a novel loan-level dataset of all 54,881 loans and bonds issued by 120 emerging markets and developing economies to private external creditors since 1970. We show that sovereigns almost always retain partial market access, even during years of outright default. Instead, defaults are costly because they erode a sovereign's creditor base. We find that defaulters rely on a narrower set of creditors, enter into fewer and smaller loan agreements and experience a contraction in new credit volumes of more than 50 percent that persists for over a decade. To rationalize these patterns, we build a model with an endogenous creditor structure and illustrate how default-induced, reputation-driven creditor attrition has negative long-run effects on borrowing conditions and debt-carrying capacity.

Keywords: Sovereign debt and default, market structure, market exclusion

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1 Introduction

A fundamental question in international finance is why sovereigns repay their external debts in the absence of supranational legal enforcement. Since the seminal contribution of Eaton and Gersovitz (1981), a large literature has argued that the threat of market exclusion is a key mechanism that sustains sovereign debt markets by deterring opportunistic behavior. According to this theory, governments honor their obligations to preserve access to future financing and to avoid the costs of financial isolation. While notable theoretical challenges to this mechanism have been raised (Bulow and Rogoff, 1989), market exclusion remains a quintessential feature of workhorse models of sovereign debt and default. Importantly, market exclusion is far from a theoretical shortcut: a large body of empirical work has documented post-default exclusion periods of multiple years, although estimates vary widely and suffer from potentially severe measurement error (Schmitt-Grohe and Uribe, 2017; Mitchener and Trebesch, 2023).

This paper revisits market exclusion and credit-market-based default costs using a new, confidential loan-level dataset covering all 54,881 external bank loans and bonds contracted by public sector borrowers in 120 emerging market and developing economies (EMDEs) from 1970 to 2020, which we construct from the World Bank's Debtor Reporting System. This loan-level data offers three key advantages over the existing literature: First, it allows us to trace borrowing patterns around default episodes at the level of 1,886 individual private creditor entities, thereby uncovering market access at the creditor level. This allows to overcome a fundamental measurement problem that has plagued prior work: aggregate debt flow measures mask new lending when fresh financing from some creditors is exceeded by repayments to existing creditors. We show that this has led to substantial overstatement of market exclusion in the literature. Second, creditor-level debt flows enable us to reveal compositional changes in sovereign debt markets that are hidden in aggregate debt statistics. And third, the granularity of the data enables us to estimate default costs with high-dimensional fixed effects that absorb a wide range of observed and unobserved confounders.

Our empirical analysis yields three main findings that challenge the conventional market-exclusion view while uncovering a different set of default costs. First, we show that sovereigns typically retain partial market access, even during years of outright default. Around two thirds of sovereigns manage to re-access credit with *some* international private creditors during the first year after a default and well before concluding a debt restructuring agreement. The median 'exclusion' time is 9 months. This stands in sharp contrast to prior estimates based on aggregate data, which imply median exclusion periods of three to seven years after default (Gelos et al., 2011; Cruces and Trebesch, 2013; Schmitt-Grohe and Uribe, 2017; Dias et al., 2024). Our result suggests that the threat of full market exclusion – a cornerstone of existing theory – has been overstated in the literature. Indeed, we show that our new estimates of exclusion duration are insufficient to sustain observed debt levels and default frequencies in standard sovereign debt models (Arellano, 2008). Critically, even models that incorporate additional default costs—such as direct output losses—implicitly treat these as consequences of market exclusion, so that their quantitative impact vanishes when exclusion itself is absent.[1]

The absence of complete market exclusion does not imply that sovereign default is costless. We show that defaults come with pronounced creditor attrition and substantially alter the depth and composition of a sovereign's creditor base. On average, more than half of a sovereign's private external creditors never resume lending after default, forcing the sovereign to rely on a narrower pool of counterparties. We further show that new lending predominantly comes from creditors that specialize in the provision of loans to distress sovereigns. Leveraging a revealed-preference measure of creditors' risk tolerance based on creditor portfolios, similar to Clayton et al. (2024), we show that average creditor ranks drop by 20 percentile points over a decade post default, implying increasing reliance on distress specialists. This shift occurs in part because bond markets, an important source of credit pre-default, deny new bond issuance for extended periods of time.

Third, the erosion of the creditor base has important implications for the supply of new credit to the sovereign. Using a Poisson pseudo-maximum likelihood local projections difference in difference estimator with granular fixed effects, we show that new credit flows contract sharply after default. On average, new credit falls by 53%, with the penalty peaking at around 90% in the fourth year post default before a slow and partial recovery sets in. The credit contraction is highly persistent. On average, it takes sovereigns more than a decade to fully recover to pre-default levels. These findings are consistent with a post-default shift in the credit supply curve, wherein sovereigns face both a reduced pool of active creditors and less elastic credit supply.[2] While we do observe increases in borrowing costs post-default, they remain moderate, suggesting that the primary adjustment mechanism operates through equilibrium quantities rather than prices.

The empirical patterns we document are hard to reconcile with canonical sovereign debt models in the tradition of Eaton and Gersovitz (1981) or Arellano (2008), which feature a single representative creditor, full market exclusion after default, and minimal long-run costs. While our paper's primary contribution is empirical, we illustrate a mechanism that can explain our findings using a dynamic reputation model with heterogeneous, habitat-based investors. In this framework, default costs operate primarily through shifts in credit supply curves rather than through complete exclusion. Following default, the pool of active creditors endogenously shrinks to specialized relationship lenders, rendering credit supply less elastic. Sovereigns respond monopolistically by restricting borrowed quantities to contain the resulting increase in borrowing costs. Rebuilding reputation requires continued borrowing from this narrower set of risk-tolerant creditors. Post-default lending from distress specialists thus becomes instrumental to the reputation-rebuilding process, gradually

[1] Mendoza and Yue (2012) provide a micro foundation for how exclusion may drive direct output costs. In their set-up, both the government and private firms are excluded from international financing after a sovereign default. Without access to working capital, firms need to replace imported input goods with imperfect substitutes, which creates efficiency losses.

[2] This is in line with Fang et al. (2025) who show evidence of sloped credit supply curves, driven by market segmentation.

restoring access to the full spectrum of creditors. As reputation improves, sovereigns regain access to larger creditor bases, including broader public bond markets, and benefit from expanded borrowing capacity.

An attractive feature of this model class is that it helps to explain the persistent effects of sovereign default on debt-carrying capacity, borrowing costs and future risk of debt distress (Amador and Phelan, 2021, 2023). In our version of the model with heterogeneous creditors, serial default and "debt intolerance" emerge endogenously as a direct consequence of the erosion of the creditor base after default. A defaulting sovereign severs ties with a large share of its existing creditors and therefore faces lower demand for its debt and a temporary increase in borrowing costs going forward. This explains why opportunistic governments have a stronger incentive to default on their remaining creditor base soon after having resolved a previous episode. In contrast, sovereigns with high standing in the market, including access to the public bond market, face comparatively high costs of default and are less likely to default at any point. Our empirical analysis and the heterogeneous agent model thus provide a micro foundation for the persistent effects of sovereign default that is purely based on credit market dynamics and replicates well-documented patterns of serial default, debt intolerance and deteriorated borrowing conditions (Savastano et al., 2003; Reinhart and Rogoff, 2009; Qian et al., 2011; Cruces and Trebesch, 2013; Meyer et al., 2022).

Related literature: First and foremost, our paper contributes to a large empirical literature on the costs and consequences of sovereign defaults (see, e.g. Borensztein and Panizza, 2009; Hébert and Schreger, 2017; Arteta and Hale, 2008; Levy-Yeyati and Panizza, 2011; Tomz and Wright, 2013; Reinhart and Rogoff, 2009; Reinhart and Trebesch, 2016; Schumacher et al., 2021; Meyer et al., 2022; Graf von Luckner et al., 2024; Mitchener and Trebesch, 2023; Farah-Yacoub et al., 2024). Within this literature, our paper is most closely related to existing empirical efforts to estimate market exclusion after sovereign default, either by applying survival analysis (Cruces and Trebesch, 2013; Gelos et al., 2011; Richmond et al., 2024; Asonuma and Trebesch, 2016); or through historical accounts of market access during and after debt crises (e.g. Sachs, 1989; Lindert and Morton, 1989; Eichengreen and Portes, 2000; El-Erian, 1991; Calvo et al., 1993; Tomz, 2007; Drelichman and Voth, 2011; Flandreau, 2013; Reinhart et al., 2017). This literature has established market exclusion as a primary cost of sovereign default. Our analysis arrives at a more skeptical conclusion and suggests that market access is best viewed as a continuous rather than a binary concept, at least in modern sovereign debt markets. We instead highlight the role of sovereigns' creditor structures in explaining the costs of sovereign defaults.

In this sense, our paper also speaks to the design of sovereign debt and default models. Since the pioneering work of Eaton and Gersovitz (1981) and Bulow and Rogoff (1989), this literature has explored the mechanisms that sustain external sovereign debt markets in environments of limited enforcement. Most of today's canonical sovereign debt and default models feature market exclusion and output costs as core ingredients to match real world data on debt, default, and interest rate spreads (Aguiar and Gopinath, 2006; Arellano, 2008; Hatchondo et al., 2016; Bocola, 2016). An important exception is Arellano et al. (2023), which features continuous sovereign borrowing during episodes of partial default. Our results complement their work and suggest that moving beyond binary modeling of market access and exclusion and towards richer debtor-creditor dynamics is a particularly promising avenue to explain empirical regularities of sovereign debt markets.

The qualitative, reputation-based default model with an endogenous creditor structure that we build in this paper is a first step in this direction. It stands in the tradition of reputation models with incomplete information and exogenous type switches, building on the seminal contributions of Kreps and Wilson (1982), Milgrom and Roberts (1982), and Barro (1986), as well as on more recent applications to fiscal policy (Phelan, 2006), capital controls and reserve currency status (Clayton et al., 2024, 2025). Within the context of sovereign debt and default, our model connects to reputational frameworks featuring alternating government types (Cole et al., 1995; Cole and Kehoe, 1995, 1998; Alfaro and Kanczuk, 2005; D'Erasmo et al., 2008; Egorov and Fabinger, 2016; Dovis, 2019; Fourakis, 2021), and directly builds on the recent works by Amador and Phelan (2021, 2023). In contrast to these works, our analysis endogenously links reputation to evolving creditor structures.

Our paper also relates to a broader and growing literature in finance that uses granular, micro-level data to uncover dynamics invisible in aggregate analysis. In corporate finance, this approach has documented how lending relationships and bank characteristics shape corporate debt structures and credit access (e.g. Chodorow-Reich, 2014; Rauh and Sufi, 2010; De Haas et al., 2025; Rajan and Zingales, 1995; Graham and Leary, 2011) as well as borrowing conditions and firm performance (Amiti et al., 2025; Schwert, 2018). In the literature on international finance, security-level holdings data have been used to revisit the international allocation of capital, highlighting how ownership structure matters for financial stability and asset pricing in ways that aggregate data cannot reveal (see, e.g. Maggiori et al., 2020; Coppola et al., 2021; Morelli et al., 2022; Florez-Orrego et al., 2024). In sovereign debt markets, a growing number of papers has explored the drivers and effects of creditor heterogeneity (Horn et al., 2021; Converse and Mallucci, 2023; Diebold and Hack, 2025; Fang et al., 2025), but comparable micro-level analysis has been scarce. Our paper fills this gap by constructing the most granular loan-level dataset for sovereign borrowing to date and by showing how such data allow us to reinterpret central propositions of the sovereign debt literature.

This paper proceeds as follows: The next section presents our novel loan-level dataset of sovereign debt markets. The third section uses this data to revisit market exclusion after sovereign default and the fourth section revisits the costs of default in light of our findings. Section 5 presents a reputation-based debt and default model to interpret our new findings. The final section concludes.

2 A new micro-level dataset of sovereign debt markets

A key contribution of this paper is the construction of a new micro-level dataset of the creditor structure of sovereign debt markets since 1970. The key novelty of this data is its unique granularity: our data is compiled at the level of the individual creditor entity and captures *all* 50,778 loans and 4,103 bonds that public debtors in 120 EMDEs have contracted with foreign commercial banks and bondholders between 1970 and 2020. This section introduces key features of this data (Section 2.1) and gives an overview of the data construction process (Section 2.2). For additional information, we refer interested readers to our detailed Online Appendix A.

Scope of data collection: Our dataset captures *all* external loans and bonds that public sector borrowers in 120 EMDEs have contracted with 1,886 different commercial banks and international investors between 1970 and 2020. For a cross-section of 54,881 different lending transactions, our data documents the borrowing entity, the creditor entity, the month of the loan commitment and the face value of the loan or bond. Moreover, our data tracks each transaction over time. Specifically, we know the amount outstanding across the full life cycle of the loan from commitment until the final maturity date.

Which debtors? We track all external loans and bonds issued by EMDE public sector entities. In line with standard definitions, public debt includes obligations contracted by the central government, but also debt of subnational governments, public enterprises, as well as debt issued by private sector entities with an explicit public sector repayment guarantee (see e.g. World Bank 2024). While our dataset captures debts contracted by 9,320 different debtor entities, the large majority of borrowing (more than 90 percent) is taken up by central government borrowers.

Which creditors? On the creditor side, and consistent with the existing literature, our dataset captures lending by external, private sector creditors. We follow the World Bank (2024) in defining external debt as obligations to non-residents. Private external lending takes two main forms.[3]

- **Bonds:** Our dataset contains 4,103 public sector bonds, including both privately placed issues and marketable debt instruments traded in international capital markets, typically considered a form of "public credit" (Denis and Mihov, 2003). While bonds represent less than 10 percent of all instruments in our sample, they tend to be particularly large. The aggregate face value of bonds amounts to approximately USD 2.2 trillion, or about 50 percent of total recorded lending volumes.
- **Loans:** Our dataset contains 50,778 loans extended by 1,886 foreign commercial banks and other financial institutions, such as finance companies, merchant banks, or insur-

[3] Throughout this paper, we exclude lending by official (bilateral and multilateral) creditors from our analysis. Lending by official creditors is typically counter-cyclical around default episodes, increasing when lending by private creditors declines (Horn et al., 2020). We also exclude "tied" forms of private sector lending, such as trade credit.

ance companies. Although direct loans are far more frequent than bonds in our sample, their aggregate face value—USD 2.3 trillion—is comparable to that of bonds. Direct loans fall into two categories. Syndicated bank loans involve groups of banks jointly providing funds under a single loan contract. Owing to their structured nature, some syndicated loans are traded in secondary markets and thus constitute another form of "public credit." Second, our data also includes direct loans that are based on a bilateral arrangement between a single financial institution and a public sector borrower. These instruments are negotiated bilaterally, are non-marketable and resemble forms of "private credit" in domestic contexts (Denis and Mihov, 2003). A defining feature of this class of debt is its opacity. Private bank loans are notoriously hard to track and are particularly prone to be under-reported in official debt statics and market sources (Horn et al., 2024; Ellias and de Fontenay, 2025). Our comprehensive, loan-level coverage of this class of external credit is a key advantage of our data over other datasets that have been commonly used to study sovereign debt markets.

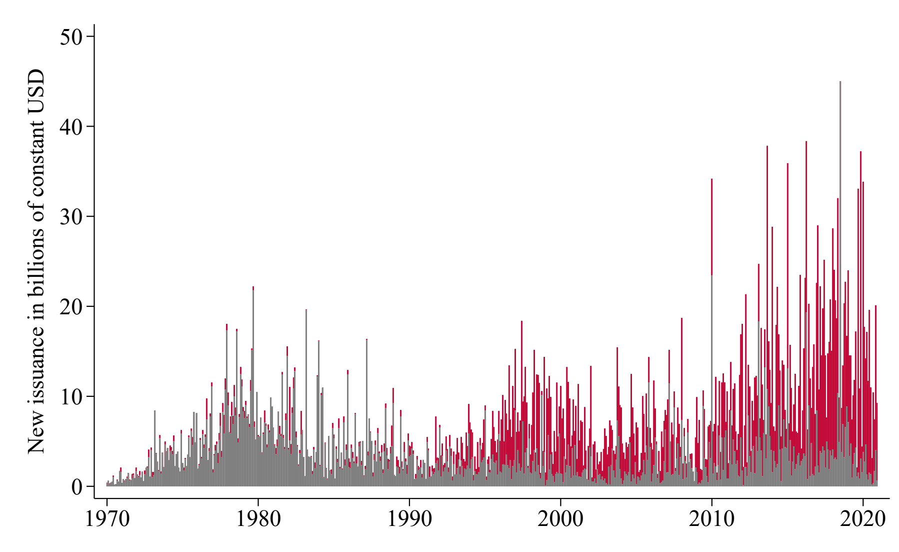
Figure 1 provides an overview of our dataset by showing the prevalence of external bond and loan financing for EMDE public sector borrowers over time.

Data construction: The starting point for our analysis is a confidential and uniquely granular extract from the World Bank's Debtor Reporting System (DRS). Data from this system underlies the World Bank's International Debt Statistics and is reported directly by the debtor countries. All countries with outstanding debt to the World Bank are contractually obliged to report their external debt liabilities at the loan level. More specifically, our extract covers the name of the creditor entity, the name of the debtor entity, the month of commitment, the face value of a loan or bond, and the associated outstanding debt stocks over time.

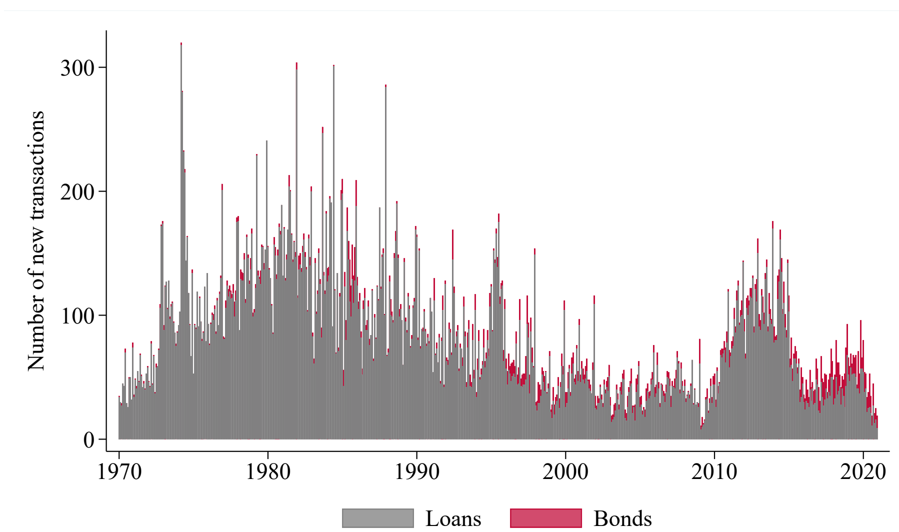
Creditor and debtor entity names in the DRS are reported by debtor countries and have not been standardized by the World Bank. A key part of our data construction effort therefore involves cleaning and standardizing this variable to ensure consistent identification of individual creditor institutions across time and countries. To do so, we rely on both algorithmic and manual identification of creditor entity names. In a first step, we leverage both traditional string similarity methods and large language model-based matching via the Hugging Face Transformers library (Wolf et al., 2020), to identify creditor entities with highly similar spelling. This approach detects minor variations in creditor entity names that would otherwise prevent a match - for example "Citibank N.A." and "Citibank NA". In a second step, we manually review all matches proposed by the algorithm and harmonize and consolidate creditor entities whenever applicable (see again Appendix Section A for details).

Figure 1: External loan and bond financing by EMDEs, 1970-2020

Panel A: Volumes



Panel B: Number of transactions



Notes: This figure shows new monthly loan and bond issues by public sector borrowers in 120 different EMDEs according to our new database. Grey bars indicate new loans, whereas red bars indicate new bond issues. Panel A shows the issued volumes in constant 2020 USD per month, whereas Panel B shows the number of transactions. See text and Appendix A for details.

3 Revisiting market exclusion

In this section, we leverage our new loan-level data to revisit post-default market exclusion. Before we present and discuss our results, the first subsection sets the stage by discussing key measurement issues.

3.1 A primer on measuring market exclusion

Measuring and analyzing the duration of market exclusion after a default event requires three elements: The start date – typically the default or restructuring event (Section 3.1.1); the end date – the point of reentry into the international capital market (Section 3.1.2); and a method to analyze the duration between these two dates across many events, i.e., a survival function (Section 3.1.3). We discuss each of these three elements in turn and highlight how our approach differs from the existing literature.

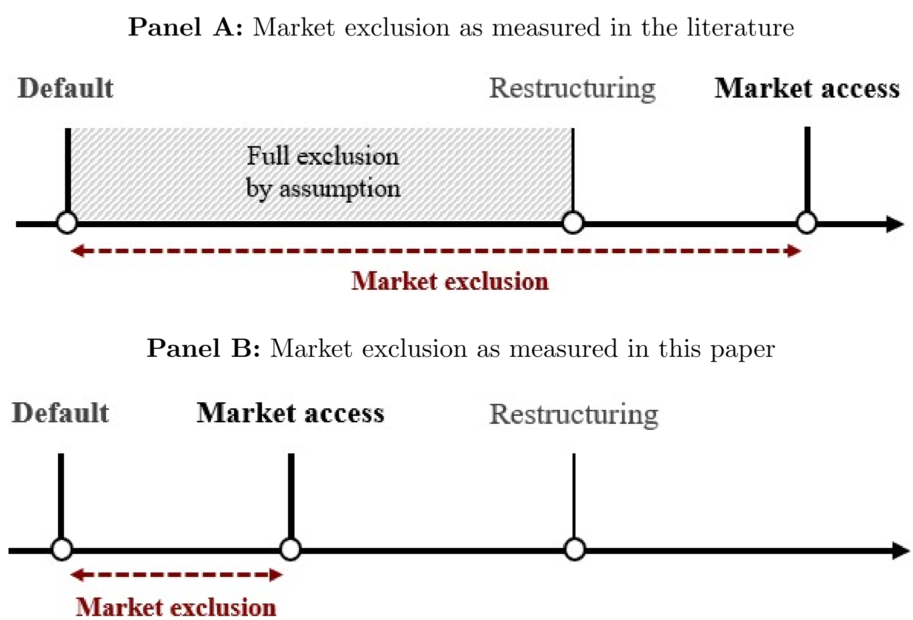
3.1.1 Defining the default event

The existing literature typically measures the duration of post-default market exclusion starting from the date of the debt restructuring between the sovereign and its external creditors (see Panel A of Figure 2). This approach rests on the assumption that sovereigns cannot access international capital markets as long as they are in default status.[4] Under this assumption, the total duration of exclusion from capital markets is the sum of (i) the time required to restructure debts with private creditors and (ii) the duration of market exclusion after the restructuring has been completed (Schmitt-Grohe and Uribe, 2017).

The assumption that sovereigns cannot borrow while in default is problematic, however, since nothing prevents creditors from providing new financing to a sovereign in default (Schmitt-Grohe and Uribe, 2017). Indeed, as we discuss in much greater detail below, our micro data shows that sovereigns routinely borrow from private external creditors before concluding a conclusive restructuring agreement.

[4] Cruces and Trebesch (2013), for example, state that "it is now a well-established stylized fact that countries are not able to borrow during default." Similarly, Richmond et al. (2024) argue that "technically, a country does not have access to capital markets while in default".

Figure 2: Illustrative timelines for measuring market exclusion



Notes: This figure illustrates different timing conventions used to estimate market exclusion duration after default and the common exclusion assumption made in the existing literature. See Appendix Section B.1 for a detailed literature review.

To measure the duration of exclusion, we therefore apply a more comprehensive event definition (see Panel B of Figure 2): Rather than assuming zero lending between default and restructuring and focusing only on the post-restructuring period, we begin our assessment at the default date, recognizing that market re-entry may occur well before formal restructurings are finalized. More precisely, we rely on the widely used measure of sovereign payment default compiled by Asonuma and Trebesch (2016) as the start point of our exclusion analysis. This source tracks default events between sovereign debtors and their external private creditors at monthly frequency since 1970. It is important to note that this data by design includes only those sovereigns that have borrowed from private creditors at least once in the past. This data and our analysis therefore do not speak to the costs of default in several of the lowest-income countries in the world that have never been able to tap international *private* credit markets and instead rely exclusively on borrowing from international organizations and bilateral donors (see e.g. Reinhart, 2002).

3.1.2 Defining market access

Market exclusion ends as soon as the sovereign is able to re-enter the international capital market, that is the sovereign receives new lending from at least one international private creditor. Formally, we define market access as:

$$A_{it} = \mathbf{1}\left[\sum_j L_{jit} > 0\right] \tag{1}$$

where A_{it} is a binary indicator of market access for sovereign i at time t, L_{jit} represents new credit extended by creditor j to sovereign i at time t, and $\mathbf{1}[.]$ is an indicator function. Thus, $A_{it} = 1$ if the sovereign receives fresh financing in period t, reflecting the notion that the debtor "can borrow".

Measuring market access on the basis of aggregate data, however, is non-trivial, and the existing empirical literature on market exclusion has used different criteria and data sources to define market access (see Appendix B.1 for a detailed review). A common challenge is distinguishing new external financing from 'defensive lending' by existing creditors. In situations of debt distress, existing creditors may extend new loans to finance upcoming principal and interest payments, effectively rolling over existing debt without providing the sovereign with fresh financing. This was especially important at the height of the 1980s debt crisis, for example in Mexico and Argentina, when many banks were highly exposed to distressed sovereign debtors. Following unilateral declarations of default in many neighboring countries, the largest creditors agreed to extend billions of dollars in new loans—matching interest payments coming due—in order to "forestall unilateral suspension of payments" (Sachs and Huizinga, 1987; Bowe and Dean, 1997). To address this issue, the existing literature has typically relied on two necessary conditions for a sovereign to be deemed to have regained market access (Cruces and Trebesch, 2013; Gelos et al., 2011; Dias et al., 2024): (i) the sovereign must be able to issue a loan or bond in the international market, and (ii) it must record net aggregate debt inflows. The second condition translates into requiring that aggregate debt stocks towards foreign private creditors increase in the year of market access. Formally,

$$\hat{A}_{it} = \mathbf{1}[\text{DebtStock}_{it} > \text{DebtStock}_{it-1}], \tag{2}$$

While the issue of a new loan or bond is typically identified in micro-level datasets such as Dealogic, increases in net indebtedness have been inferred from aggregate debt stocks, in particular from the World Bank International Debt Statistics (see again Appendix B.1 for details).

As we discuss in greater detail below, a key limitation of this approach is that aggregate data may mask compositional changes in the debt stock. Market access with *some* creditors can remain undetected if the sovereign simultaneously makes large repayments to other creditors that exceed new financing, thereby causing the aggregate debt stock to decline.

Our approach overcomes this limitation by leveraging the granular information in our new dataset. Because we have assembled data on both outstanding amounts and new lending transactions at the level of the individual creditor entity j, we can directly observe new lending flows ($L_{jit} > 0$). More precisely, and to rule out defensive lending, we estimate market access as

$$\hat{A}_{it} = \mathbf{1}[\exists j : \text{DebtStock}_{jit} > \delta \text{DebtStock}_{jit-1}], \tag{3}$$

where δ is a scaling parameter and subscript j indicates that we identify market access whenever outstanding debts with a *single* creditor entity increase. Our baseline approach therefore closely matches the market access definition employed in the literature, but implements it at the level of individual creditor entities. In contrast to existing contributions, we are therefore able to identify market access even when the sovereign reduces its external debts to private creditors as a whole. While our baseline criterion captures all instances in which a creditor increases its exposure by any amount ($\delta = 1$), we later show that our results are robust to varying the market access definition and are not driven by very small instances of market access (i.e. we set $\delta > 1$). These robustness checks are important to ensure that market access is indeed a form of net lending and not just the result of interest arrears securitization as in the 1980s debt crisis (Sachs and Huizinga, 1987).

3.1.3 Estimating survival functions

To analyze the duration of market exclusion between the default event and market reaccess, we follow the existing literature and employ the non-parametric Kaplan-Meier estimator to construct empirical survival functions (e.g. Cruces and Trebesch, 2013; Dias et al., 2024). The estimator computes the compound probability that a defaulting sovereign remains excluded from markets for each month post-default, defined as

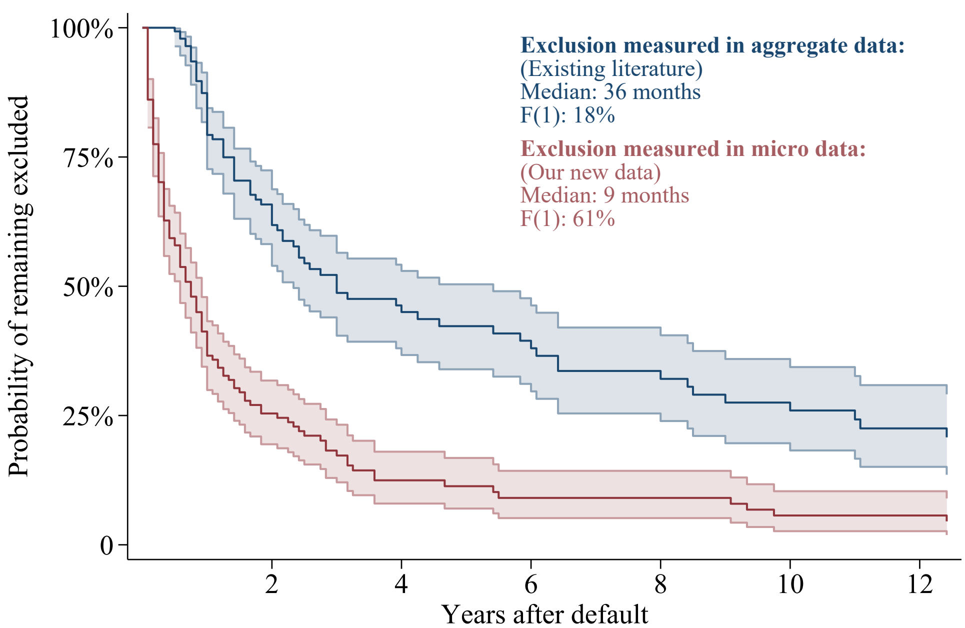
$$\hat{S}(t) = \prod_{i=0}^{t} (1 - \frac{d_i}{n_i}),$$

where t denotes the number of months post-default at which the survival probability is evaluated, with the product taken over monthly intervals $i = 0, 1, \ldots, t$; d_i represents the number of defaulters regaining market access at time i and n_i denotes the number of defaulters still excluded at time i post default. This approach has three important methodological advantages. First, as opposed to first and second moments, Kaplan-Meier functions display the full distribution of reaccess times across default episodes. Second, the non-parametric nature of the estimator imposes no distributional assumptions on exclusion duration. Third, the methodology naturally handles censored observations, accounting for sovereigns that never regain market access during the sample period.

3.2 Market access after default

Figure 3 shows the key result from the Kaplan-Meier estimator. The red survival function presents the compound probability of market exclusion post-default as measured in our micro data. It is striking how fast sovereigns re-access some form of private external lending. Almost two thirds of all defaulting sovereign regained access to some form of new private lending within a single year. This is in stark contrast to existing results in the academic literature. We exemplify this by showing a Kaplan-Meier estimate of market exclusion if exclusion is determined in aggregate data (in blue). To construct this estimate, we follow the existing literature's typical approach and define market access as any year, in which a sovereign experiences both (i) a new bank or bond loan and (ii) positive net financial flows from private external creditors at the *aggregate* level (see Section 3.1.2 and Appendix B.1 for details). Measured at the aggregate level, only 30 percent of sovereigns achieve market re-access within the first year and the median exclusion period increases by a factor of almost 3 - from 9 to 26 months.[5]

Figure 3: Market exclusion after default: Micro vs. aggregate data



Notes: This figure plots Kaplan-Meier Survival Functions for market exclusion after sovereign defaults. The red line shows the probability of remaining excluded from the market as measured in our novel micro level-level data (see Section 2). The blue line shows the probability of remaining excluded as measured in aggregate data (see Section 3.1.2). Shaded areas indicate 90% confidence intervals. F(1) refers to the compound probability of re-accessing the market within the first year post-default. Data on sovereign default events is from Asonuma and Trebesch (2016).

A particularly striking implication from the micro data is that more than 75 percent of sovereigns are able to tap the market *before* they achieve a conclusive restructuring with

[5]Here we are comparing the aggregate and the micro-level approach based on a common starting point - the default month. There are even larger discrepancies between our results and the existing results given that most existing papers assume zero lending between default and restructuring (see Figure 2).

their external private creditors.[6] In sharp contrast to the existing literature that typically rules out market access during default by assumption, our results show that "there is life *in* default".

Not all sovereigns, however, are able to re-access markets quickly. At the very right tail of the exclusion distribution, we identify several cases in which sovereigns remained shut out of international capital markets for multiple years. These episodes include defaults in some of the poorest economies of the world that had only briefly tapped external private creditors before defaulting and then remained excluded for ten years or more (e.g. Cote d'Ivoire, Guinea, Madagascar or Mauritania). They also include countries that defaulted in the context of severe political and institutional crisis or war (e.g. Albania 1991 and Vietnam 1982). In line with findings by Cruces and Trebesch (2013), Asonuma and Trebesch (2016) and Graf von Luckner et al. (2024), a common characteristic of these episodes is that they imposed particularly large net present value losses on private international creditors, e.g. 90 percent in the case of Mauritania or 80 percent in the case of Albania (see Appendix Section B.3 for a full list of episodes and several detailed historical case studies).

Robustness and extensions: Table 1 expands the preceding analysis by showing that fast market re-access is not purely driven by small or quantitatively irrelevant transactions. For this purpose, we vary the re-access definition introduced in Section 3.1.2 and analyze different concepts of market access in the micro data. First, we increase the size threshold δ for a new loan to be considered market access. The table shows that our market access estimates remain virtually unchanged when we require the debt stock to an individual creditor to increase by more than the average coupon payment in our data ($\delta = 1.08$). The same holds when we require the debt stock to the individual creditor to increase by a factor of up to 2 ($\delta = 2$), well above plausible magnitudes for potential interest-arrears securitization.

Second, we show that our result also hold when we only focus on cases of market reentry with new creditors. For this exercise, we distinguish between borrowing at the extensive and intensive margin. Access at the intensive margin occurs when the sovereign borrows additional funds from existing creditors, whereas access at the extensive margin occurs when it borrows from an external private creditor with no outstanding claims on the sovereign in the current year. Accessing the market at the extensive margin can be considered a particularly strong signal, as — by definition — such *arm's-length* lending cannot serve defensive purposes. Table 1 shows that almost half of defaulting sovereigns contract lending from new creditors within the first year of default.

[6] On average, it takes sovereigns roughly 3.75 years to achieve a conclusive restructuring with their external private creditors (Cruces and Trebesch, 2013).

Table 1: Market exclusion in micro vs aggregate data - different definitions

	Market exclusion in months			
	1st Quartile	Median	3rd Quartile	F(1)
Micro data				
$\delta = 1$	3	9	25	0.61
$\delta = 1.08$	3	9	27	0.60
$\delta = 2$	4	12	34	0.52
Extensive margin only	4	14	40	0.45
Aggregate data				
Net flows > 0	15	36	132	0.18

Notes: This table shows non-parametric Kaplan-Meier estimates of market exclusion after Asonuma and Trebesch (2016) default events in months. The table distinguishes between estimates derived in our new micro data and estimates derived in aggregate data as well as between different concepts of market access (see text and Sections 2 and 3.1.2). F(1) refers to the compound probability of re-accessing the market within the first year post-default. For additional robustness exercises and full Kaplan-Meier survival function plots see Appendix Section B.4.

3.3 Why do our results differ from existing estimates?

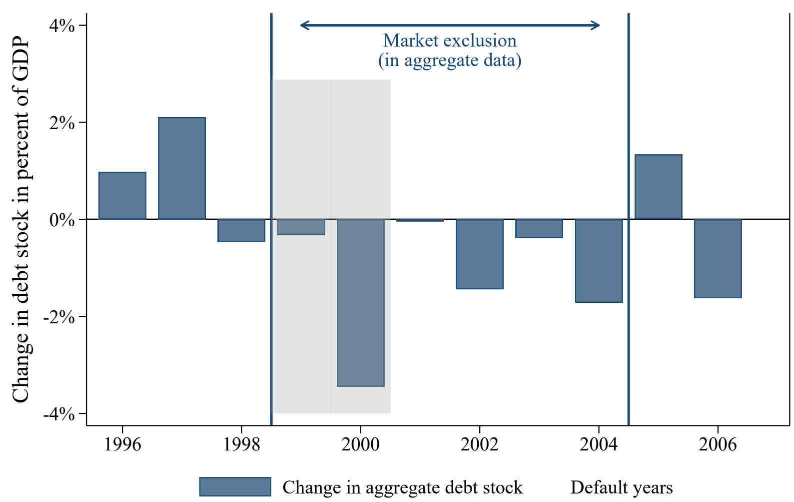
The striking difference between our estimates of market exclusion after default and the existing literature warrants further investigation. In this subsection, we take a detailed look at our micro data to explore why previous studies report substantially longer exclusion periods. We exemplify our arguments by making reference to Ecuador's 1999 default episode as shown in Figure 4. Similar case studies and graphs for other countries are shown in an episode archive in Appendix B.3.

Figure 4 summarizes Ecuador's access to external markets before, during and after its 1999 sovereign default through the lens of both aggregate (Panel A) and our novel micro-level data (Panel B). Panel A shows aggregate net financial flows, expressed in percent of GDP, between Ecuador and its external private creditors. As explained in Section 3.1.2, positive net financial flows are associated with net increases in the outstanding debt stock and are a necessary condition for market access in the existing empirical literature. As shown in Panel A, Ecuador recorded negative aggregate net financial flows for six consecutive years after defaulting on external private creditors in 1998. Net financial flows only turned positive in 2005, five years after restructuring its external debts with private creditors – a point commonly marked as Ecuador's reentry to external capital markets (see e.g. Cruces and Trebesch, 2013).

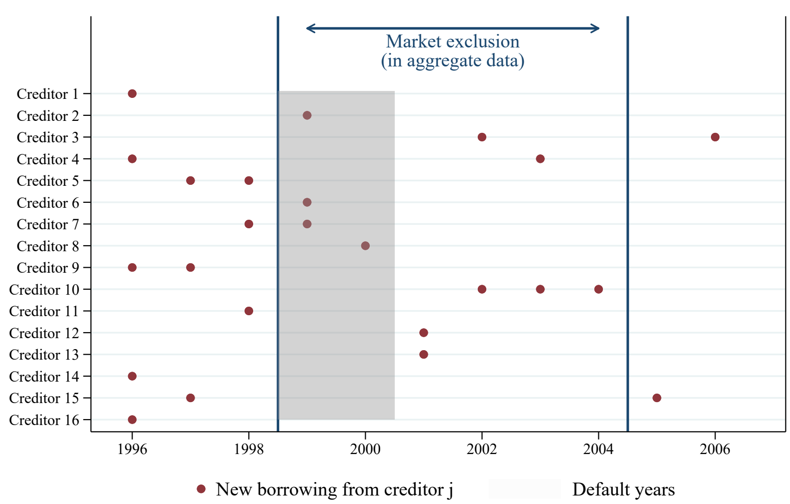
Panel B of Figure 4 analyzes the same episode through the lens of our new micro data and based on our granular definition of market access at the creditor level, as explained in

Figure 4: Market access in aggregate vs. micro data: The case of Ecuador 1999

Panel A: Market exclusion in aggregate data



Panel B: Market access in micro data



Notes: This figure shows market access by Ecuador prior, during and after its 1999 sovereign default as seen through both aggregate and micro data. Panel A shows aggregate net financial flows in percent of GDP and thereby illustrates how the existing literature has measured market exclusion after default. Panel B depicts the same episode through the lens of our novel micro data. Each new transaction follows the baseline definition provided in Section 3.1.2 with $\delta = 1$. The grey shaded bars show years between the default event and the debt restructuring and are taken from Asonuma and Trebesch (2016). For confidentiality reasons, the names of the different creditor institutions have been erased.

Sections 2 and 3.1.2. We plot all instances, in which Ecuador contracted new external loans from private creditors that led to an increase in the outstanding debt stock of that creditor. Strikingly, despite negative *aggregate* net financial flows, Ecuador continued to secure new funding from external private creditors throughout the default episode. Moreover, Panel B reveals substantial heterogeneity in creditor responses to Ecuador's default: While some existing creditors ceased lending to Ecuador, others continued to provide fresh financing. Ecuador also managed to contract funding at the extensive margin, with some creditors providing their first loans to Ecuador during or immediately after the default episode.[7]

The key insight from Figure 4 is that focusing on aggregate net financial flows can obscure market access at the level of individual creditor entities. This becomes clear when we decompose the aggregate measure introduced in Section 3.1.2 into its underlying components:

$$\hat{A}_{it} = \mathbf{1}[\text{DebtStock}_{it} > \text{DebtStock}_{it-1}], \tag{4}$$

$$\text{DebtStock}_{it} - \text{DebtStock}_{it-1} = \sum_j \text{GrossInflows}_{jit} - \sum_j \text{Repayments}_{jit} \tag{5}$$

Therefore, the aggregate access measure $\hat{A}_{it}$ equals:

$$\hat{A}_{it} = \mathbf{1}\left[\sum_j \text{GrossInflows}_{jit} - \sum_j \text{Repayments}_{jit} > 0\right] \tag{6}$$

This decomposition highlights how aggregate net flows can understate market access: if the sum of repayments to all creditors exceeds the sum of new lending — that is, if $\sum_j \text{Repayments}_{jit} > \sum_j \text{GrossInflows}_{jit} > 0$ — the sovereign has market access ($A_{it} = 1$), yet the aggregate net flow measure incorrectly records no access ($\hat{A}_{it} = 0$). In Ecuador's case, large principal payments on existing debts masked the fact that it continued to secure new borrowing from both existing and new, arm's-length external creditors, including major international banks (see Panel B).

It is particularly striking that Ecuador managed to contract new external debts *before* achieving a debt restructuring with its existing creditors. Existing papers have typically ruled out market access during default *by assumption* and have focused on market exclusion after debt restructuring. A key and novel insight from our data is that this assumption is false: countries frequently tap markets while in default on existing creditors – a possibility that earlier studies have ruled out by design.

[7]For confidentiality reasons, the names of the creditor banks have been randomized. Some of these transactions, however, can be verifiedin public sources. For example, Ecuador contracted large syndicated loans led by Deutsche Bank and BBVA in 2003 and 2004 for close to 100 million USD - while still being "excluded" from the market according to conventional estimates (see Appendix Section **??** for details and sources).

4 Revisiting the costs of sovereign default

The previous section established that sovereigns almost always retain access to some international creditors, even during outright default years. However, this does not mean that sovereign defaults are costless. In this section, we revisit the costs of default using our new micro-level data. We show that defaults are associated with an erosion of the sovereign's creditor base (Section 4.1), a shift toward private credit markets and "distress creditors" (Section 4.2), and sharp and persistent contractions in credit volumes (Section 4.3).

4.1 Erosion of the creditor base

We begin our analysis of the costs of default by examining the extensive margin of lending. To this end, we construct a simple measure of the number of active creditors for each sovereign borrower in a given year. Our primary creditor count variable, C_{it}, is defined as the total number of creditors holding outstanding debt claims on sovereign i in year t. This captures the breadth of the sovereign's creditor base, including both active lenders and legacy holders. The bond market is treated as a single creditor in this exercise, since the World Bank data does not include information on individual bond holdings.

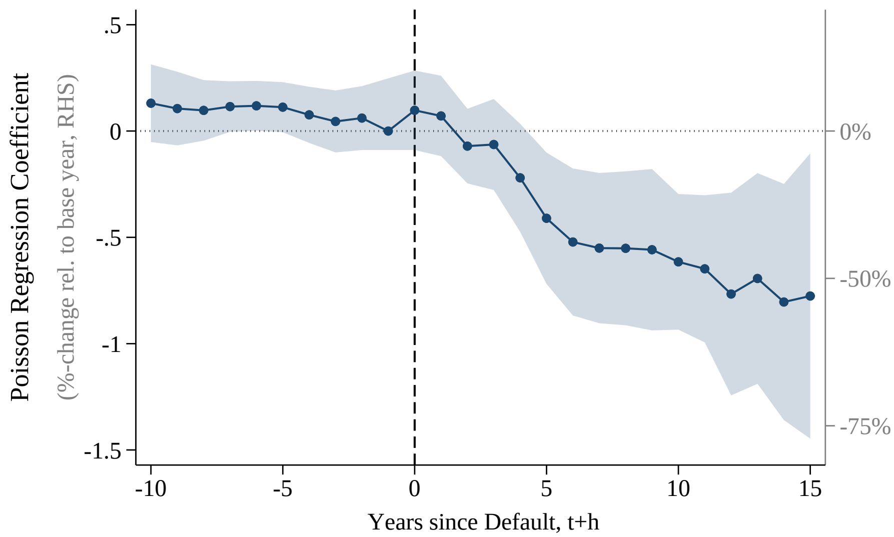
To estimate the association between default and the depth of a sovereign's creditor base, we employ a local-projections difference-in-differences (LP-DiD) framework (Dube et al., 2025). For each horizon h from ten years before to ten years after the default event, we estimate:

$$C_{i,t+h} = \exp\left(\beta_h \Delta D_{it} + \alpha_i^{(h)} + \gamma_t^{(h)}\right) \times \epsilon_{i,t+h}^{(h)}, \quad h = -10, \ldots, 0, \ldots, 15$$

where D_{it} is an absorbing indicator equal to one in all years after sovereign i has defaulted (and zero otherwise), ΔD_{it} the first difference there of. $\alpha_i^{(h)}$ are debtor fixed effects, $\gamma_t^{(h)}$ are year fixed effects, and β_h estimates the association between default and the Creditor Count, C, at horizon h periods before ($h < 0$) or after ($h > 0$) the default event. This specification leverages within-country variation over time, comparing the evolution of a sovereign's creditor base around its own default event against non-default periods, while controlling for global shocks that affect all countries in a given year. We estimate the model using an Poisson Maximum Likelihood Estimator, with standard errors clustered at the debtor level to account for serial correlation. Importantly, although debtor fixed effects absorb time-invariant country characteristics, the design does not rule out time-varying confounders that coincide with the default event, such as domestic economic crises or policy reforms that may independently influence creditor participation.

Figure 5 summarizes the results. The number of creditors drops sharply and persistently declines after default. Within around five years of the default event ($h = 0$), the sovereign loses around 30 active creditor entities on average – a contraction of around 50 percent relative to the pre-default baseline—with the effect statistically significant at conventional

Figure 5: Erosion of the creditor base - Local Projections Diff-in-Diff



Notes: This figure shows local projections diff-in-diff regressions of the number of active creditors in an unbalanced panel of 4395 sovereign-year observations across 52 absorbing default episodes in 116 debtor countries, 1970–2020. The horizontal axis shows the number of years before and after a default event. Regressions include year- and debtor country fixed effects. Dots represent point estimates and the blue shaded area shows 95% confidence intervals clustered at the debtor level. The year prior to default ($h = -1$) is omitted to allow for the interpretation of relative changes.

levels. In contrast, the pre-default coefficients (β_h for $h < 0$) are close to zero and statistically insignificant, supporting the parallel trends assumption. The effects of default are also long-lasting with point estimates remaining negative and statistically significant even twenty years post default, indicating notable scarring.

The measure in Figure 5 combines both active lenders and legacy holders of debt. As such, the observed contraction reflects both the gradual repayment of legacy creditors as well as the decline in active creditor entities. In Appendix C, we repeat the exercise by focusing exclusively on the number of creditors that are extending new credit in year t. This narrower definition yields qualitatively similar results but indicates an even steeper initial decline. This indicates that the erosion of the creditor base is not merely a mechanical result of maturing debt but reflects a marked slowdown in the formation of new creditor relationships.

Even if market access is not lost entirely, sovereigns on average experience a drastic withdrawal of counterparties after default, leaving them reliant on a smaller pool of available creditors.

4.2 Who leaves? Who returns? Exploring heterogeneous creditor responses

The preceding section established that sovereigns lose around half of their counterparties in the aftermath of default. While many creditor withdraw and never return, others continue to lend or even enter the market for the first time. What sets these creditors apart? In corporate finance, it is well established that specialized creditors with superior monitoring or enforcement capacities invest in assets other creditors avoid (Gilson et al., 1990; Carey et al., 1998). In this subsection, we investigate *how* sovereigns access the market during and after default and whether sovereign debt markets display similar sorting dynamics. We begin this analysis by contrasting the response of bond markets and banks, and then turn to evidence from creditor portfolios that reveals systematic shifts towards borrowing from "distress specialists".

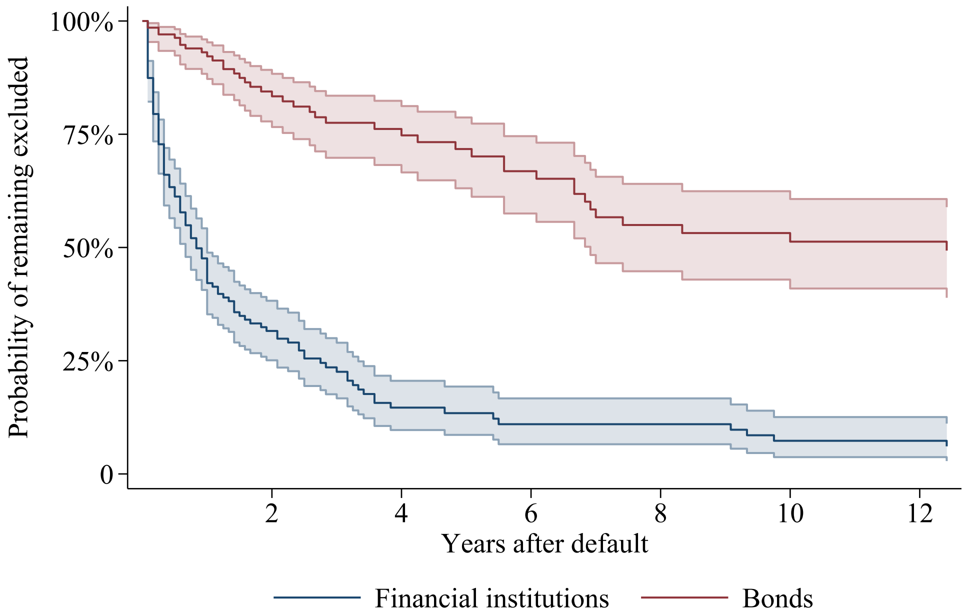
4.2.1 From public to private credit markets

A first dimension of creditor sorting is evident in the distinct default response of loan and bond markets. Figure 6 plots separate Kaplan-Meier survival functions that show the time until a sovereign manages to obtain new financing from international financial institutions (in blue) or manages to issue new bonds in the international capital market (in red) after a default event. While banks typically continue to provide new financing to the sovereign - thereby allowing it to re-access some form of external financing immediately - bond markets remain closed for extended periods of time. More than half of defaulting sovereigns fail to issue a new international bond within 10 years after default. As a result, the composition of sovereign borrowing shifts away from public bond markets and toward the private credit market.

This shift toward bank loans and private credit markets during sovereign distress may have profound implications for the composition and terms of sovereign borrowing. A growing literature highlights the unique role of private credit in bridging financing gaps that public markets cannot or will not fill, particularly for higher-risk borrowers (Cohen et al., 2024; Ellias and de Fontenay, 2025). Direct lending from these institutions may impose stricter supervision and monitoring on the sovereign, echoing foundational theories of financial intermediation. As Diamond (1984) argues, banks serve as delegated monitors, aggregating dispersed creditor interests and exerting influence through concentrated oversight that dispersed bondholders cannot replicate.

Selective access to bond markets is also in line with an earlier literature that has documented the use of market exclusion as a codified enforcement mechanism in bond markets in the early 19th century, when the London Stock Exchange formalized a policy exemplifying this practice as a mechanism to deter default and protect investors (Flandreau, 2013). In that year, following an attempt of Spain to list a new bond despite being in default to existing creditors, the Exchange's governing body declared that:

Figure 6: Time until new borrowing: Banks versus bonds



Notes: This figure plots Kaplan-Meier Survival functions for market exclusion after sovereign default. The red line shows the probability of not being able to issue a bond in the international capital market. The blue line shows the probability of not being able to borrow from international banks. Both survival functions are estimated in our novel micro data and use the access measure introduced above (see Section 3.1.2 and Section 2 for details). Shaded areas indicate 95% confidence intervals. Data on sovereign default events is from Asonuma and Trebesch (2016).

> *For the better protection of the interests of the members of the stock exchange, and the public in general [...] the committee will not sanction or take any cognizance whatever of Bargains that may be made in New Bonds [...] issued by any Foreign Government that has not duly paid the dividend on former loans* — London Stock Exchange Committee, 1827

It is important to note however, that *partial* exclusion by bond markets is incomparable in welfare terms to total market exclusion, i.e. the inability to attain any credit, prominently featured in sovereign debt models today. Even in recent decades when bonds largely dominated sovereign finance bond market exclusion has not equated to total market isolation. As our analysis reveals, defaulting sovereigns frequently sustain borrowing ties with banks and private credit funds to buffer against absolute credit denial.

4.2.2 Evidence from creditor portfolios

This subsection moves beyond the binary distinction into public and private markets and toward a comprehensive characterization of creditor entities. To characterize a sovereign creditor's risk preference, we leverage our granular micro data and follow the approach of Clayton et al. (2024), who use portfolio holdings as a measure of revealed risk preferences.

Specifically, we construct a metric that summarizes the average risk profile of all creditors active in the EMDE sovereign debt market for all years from 1970 to 2020. We then use this new measure to assess whether after defaulters increasingly rely on high-risk creditors that specialize in distressed credit and hold portfolios with low average credit quality.

More specifically, we first compute the average credit rating for the investment portfolio of each creditor j in year t as a weighted average over all debt investments across sovereign issuers. To avoid mechanical correlations, we exclude all holdings of debtor i. Let $r_{j,-i}$ denote this leave-one-out weighted average credit rating for creditor j.[8] In a second step, we rank all creditors in each year t based on $r_{j,-i}$, ordering them from lowest to highest average rating (i.e., from most to least specialized in distressed assets). Using a rank rather than the average rating itself allows us to disregard the co-movements of sovereign credit ratings over the global business cycle. We then normalize these ranks to a percentile scale ranging from 0 to 100, where a lower percentile rank corresponds to a creditor with a riskier portfolio (lower average rating). Let $\rho_{j,t}$ denote this normalized risk rank for creditor j in year t.

Our reputation measure for debtor i in year t, denoted $rank_{i,t}$, is then derived as the disbursement-weighted average of these normalized ranks across all creditors j lending to i in that year:

$$rank_{i,t} = \frac{\sum_{j \in J_{i,t}} Disb_{j,i,t} \rho_{j,t}}{\sum_{j \in J_{i,t}} Disb_{j,i,t}}.$$

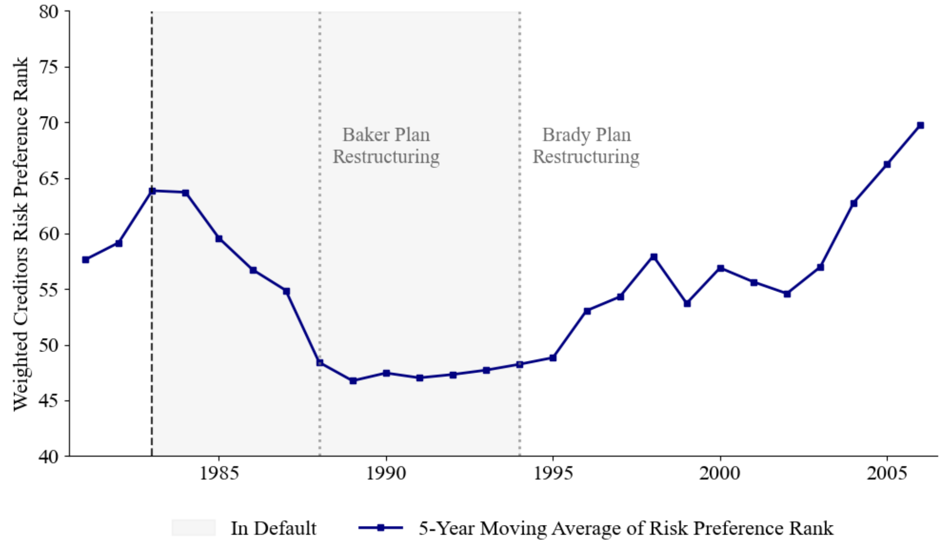
where $J_{i,t}$ is the set of creditors lending to debtor i in year t, and $Disb_{j,i,t}$ is the new credit disbursed by creditor j, to debtor i in year, t.

Figure 7 illustrates the evolution of this measure for the case of one sovereign debtor, Brazil after its default in the early 1980s. While Brazil was able to tap creditors with comparatively high average-credit quality in the 1970s, its 1982 default led to a swift and persistent reversal in the average quality of its creditor base. Only when Brazil exited default for good in the 1990s, following multiple relapses, it began to slowly rebuild its reputation on international credit markets. It took until the early 2000s, however, for it to reach the same relative standing among creditors that it had enjoyed prior to its default.

The Brazilian experience points towards an additional, potentially important cost of default - changes in the quality of the creditor base a sovereign can borrow from. To evaluate whether the Brazilian experience is indicative of a broader pattern, we again use a local projections difference-in-differences (LP-DID) approach to analyze the relationship of default and creditor risk preferences, proxied by $rank_{i,t}$. As in the previous section, we estimate:

[8] Credit ratings are numerical values where higher numbers indicate safer (higher-quality) assets. For the conversion from different credit rating scales to the numerical measure, we rely on the method used by Reinhart et al. (2017) and Horn et al. (2020) (see Appendix A for details).

Figure 7: Brazil's reputation measure from 1980 to 2005



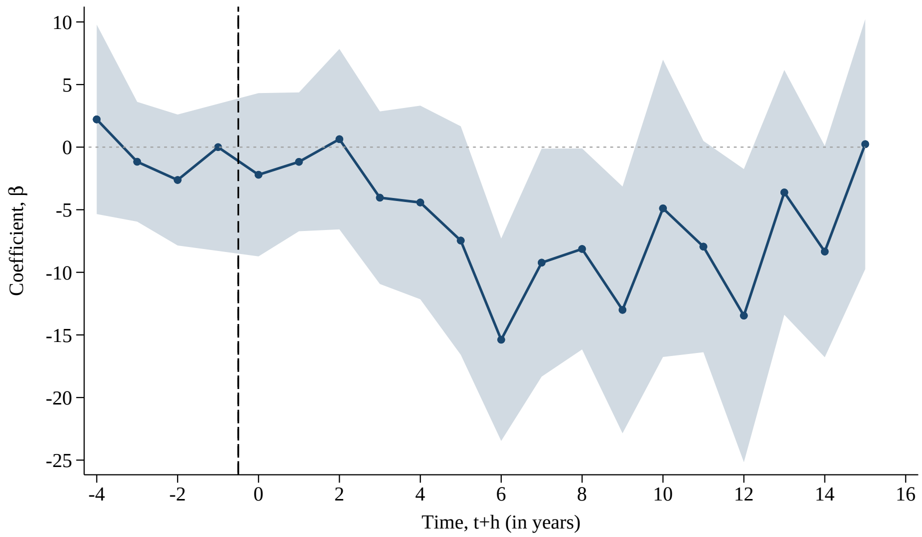
Notes: This figure shows a five-year moving average of Brazil's reputation rank $rank_{i,t}$ as defined in the text. The grey shaded area indicates default years as measured by Asonuma and Trebesch (2016).

$$rank_{i,t+h} - \overline{rank_{i,pre}} = \delta_t^{(h)} + \beta_h \Delta D_{i,t} + e_{i,t}^{(h)},$$

where $\delta_t^{(h)}$ are time effects specific to horizon h. Debtor fixed effects are omitted due to the differencing st the debtor-level, since $\overline{rank_{i,pre}}$ is the pre-treatment average of debtor i. As before, the regression is estimated on a restricted sample consisting of newly treated observations ($\Delta D_{i,t} = 1$) and clean controls ($D_{i,t+h} = 0$), ensuring that debtors in the control group have not defaulted by $t+h$. Standard errors are clustered at the debtor level. All caveats about the interpretation of coefficient from two-way fixed effects and non-random "treatment" described above are equally relevant to this application.

Figure 8 plots the estimated β_h coefficients, illustrating the evolution of creditor risk ranks around defaults. The results indicate that, within ten years post-default, debtors experience a gradual decline in the average risk rank of their creditors, as they move to borrow from creditors with riskier portfolios on average. This shift suggests a move toward creditors more specialized in distressed assets and reduced access to mainstream lenders. Sample sizes are more limited in this specification, because ratings are much more scarce in earlier time periods, when many defaults took place. As a consequence, confidence intervals are wider and we need to rely on a shorter pre-treatment period with a sufficiently large sample. Still, over that short pre-treatment period, trends are flat, supporting the parallel trends assumption.

Figure 8: Creditor reputation rank around default - Local Projections Diff-in-Diff



Notes: This figure shows local projections diff-in-diff regressions of the creditor reputation rank on an unbalanced panel of 2025 sovereign-year observations across 46 absorbing default episodes in 113 debtor countries, 1970–2020. The horizontal axis shows years before and after a default event as defined by Asonuma and Trebesch (2016). Regressions include year- and debtor country fixed effects. Blue dots show point estimates and blue shaded areas indicate 95% confidence intervals clustered at the debtor level. The year prior to default ($h = -1$) is omitted to allow for the interpretation of relative changes.

4.3 Contraction in credit volumes

The evidence in the prior section shows that sovereign defaults trigger a profound reshaping of the creditor base: many lenders exit permanently, while those that remain are disproportionately specialized in distressed credit. What are the consequences of this shift in the creditor base? In principle, costs could materialize along several dimensions, including higher borrowing costs, more restrictive contractual terms such as collateral requirements, or reduced lending volumes.[9] In this subsection, we investigate how credit volumes evolve in the aftermath of default, by analyzing the debt flows at the debtor–creditor–year level. For that purpose, we leverage the full granularity of our data and study creditor responses at the individual debtor-creditor-year level. The more granular regression design allows for the inclusion of high-dimensional fixed effects – such as debtor-creditor pair effects and creditor-year effects – that absorb a wide range of observed and unobserved confounders that the literature so far has not been able to account for. Before we turn to our preferred dynamic specification, it is instructive to analyze the response to default in a static set-up.

4.3.1 Static analysis

To estimate the average change in credit flows associated with a default, we model the volume of new money at the debtor-creditor-year level. The dependent variable, M_{ijt}, represents

[9] Due to data limitations, we cannot directly observe covenants and changes in yields are less informative (as we will discuss later in section 4.4).

the new money extended by creditor j to debtor country i in year t. Given the presence of many zero-flow observations in our loan-level data, we employ a Poisson Pseudo-Maximum Likelihood (PPML) estimator, following Silva and Tenreyro (2006) and Chen and Roth (2024). Our baseline model is:

$$M_{ijt} = exp(\beta D_{it} + \alpha_{FE}) \times \epsilon_{ijt}$$

where D_{it} is an indicator variable equal to one for all years t after sovereign i defaults. The coefficient of interest, β, captures the average percentage change in credit flows associated with being in a post-default state. ϵ_{ijt} is a multiplicative error term. The primary challenge to identifying β is a myriad of potential confounders: For instance, defaults often coincide with global financial turmoil, which independently affect credit flows. To isolate the correlation-coefficient of default from these confounders, we build towards our preferred specification by progressively introducing more granular fixed effects, that take the place of α_{FE}. This granular approach leverages the novel structure of our debtor-creditor-year micro data which allows us to control for an array of confounders — a feature not possible in prior studies reliant on aggregate sovereign debt flows.

Table 2: Poisson Regressions: New Money and Default

	(0)	(1)	(2)	(3)	(4)
β: post default	0.33**	-0.80**	-0.97***	-0.95***	-0.75**
	(3.12)	(-2.88)	(-3.98)	(-3.77)	(-2.76)
Adj. R^2	0.00	0.18	0.50	0.58	0.74
N	198 416	198 380	197 548	192 626	99 296
Debtor FE		✓	✓		
Year FE		✓	✓	✓	
Creditor FE			✓		
Debtor-Creditor FE				✓	✓
Creditor-Year FE					✓

Notes: This table shows regressions of new credit on an indicator variable for default. T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are clustered at the debtor-creditor pair level to account for potential serial correlation within bilateral relationships. The sample varies across specifications as observations without within-group variation are dropped during maximum likelihood estimation.

Table 2 reports the correlation-coefficient of default and new credit flows under increasingly granular specifications. Without any fixed effects or controls, the coefficient is positive and significant, suggesting that borrowing *increases* after default. This counter-intuitive result, however, is driven by omitted variable bias. For instance, in order to default, a country must have borrowed first, so, across the sample, defaulters might borrow more. This demonstrates the critical importance of accounting for observed and unobserved confounders.

To begin addressing this, Column (1) introduces debtor fixed effects (α_i) and year fixed effects (γ_t). This specification now controls for time-invariant country characteristics (e.g., size of the economy, institutional quality) and absorbs any global shocks common to all countries in a given year. The inclusion of these controls changes the sign of the coefficient. The coefficient on D_{it} becomes -0.796, implying a 55% reduction in new lending. However, the model in Column (1) still pools all creditors, implicitly assuming they are homogeneous. This is a strong assumption, as different lenders have different mandates and lending patterns. If the composition of creditors changes systematically after a default, our estimate of β would be biased. Column (2) addresses this by adding creditor fixed effects (δ_j). The coefficient estimate becomes more negative (-0.974), suggesting a 62% reduction in credit. In line with our analysis of default-induced changes in the creditor base (Section 4.1), this indicates that sovereigns receive a larger share of their post-default financing from creditors who tend to lend less on average. Failing to control for this compositional effect understates the true contraction in credit.

Column (3) further controls for the unique, time-invariant nature of specific borrowing relationships by replacing individual debtor and creditor effects with debtor-creditor fixed effects (θ_{ij}). This absorbs all unobserved, persistent factors specific to a given debtor-creditor pair, such as historical ties, political alliances, or specialized expertise. The estimate for β remains large and stable at -0.949. Finally, Column (4) presents our most granular specification by including both debtor-creditor fixed effects (θ_{ij}) and creditor-year fixed effects (δ_{jt}). This specification absorbs any unobserved, time-varying shocks to a creditor's lending capacity and isolates the impact of default by comparing the change in lending from a specific creditor to the defaulting sovereign against the change in that same creditor's lending to its other, non-defaulting clients in the same year. The resulting coefficient of -0.748 implies a 53% reduction in credit flows.

An important caveat to our research design concerns the potential violation of the Stable Unit Treatment Value Assumption (SUTVA), which requires that the treatment status of one debtor country does not affect the outcomes of another. Given the well-studied contagion in sovereign debt markets (Kaminsky and Reinhart, 2000), any empirical research on sovereign default falls subject to these concerns, since SUTVA risks to be violated either because a default by a major emerging market sovereign could trigger global contagion, causing a general flight to safety and reducing credit flows even to non-defaulting countries. Conversely, a default in one country might free up creditor capacity, potentially increasing lending to other countries. Our research design mitigates these concerns to some extent. The inclusion of Creditor-Year fixed effects (δ_{jt}) in our preferred specification absorbs any average shock to a creditor's lending capacity or strategy in a given year, which would capture the effects of a major global or regional contagion event on that creditor's overall lending. However, we cannot fully rule out more complex spillovers, where a default by country A specifically changes a creditor's perception of risk for a neighboring or economically similar country B.

4.3.2 Dynamic analysis

While the static analysis allows us to absorb a wide set of confounders, it still has three important shortcomings: First, it treats the post-default period as a permanent state, which may mask the evolution of the penalty over time. Second, it is silent about the validity of the parallel trends assumption – that is, that absent the default, credit flows to the treated (defaulting) country would have evolved similarly to those of the control group. Especially since we cannot employ debtor-year fixed effects, the TWFE estimation cannot rule out the possibility that an unobserved, time-varying and country-specific or creditor-specific shock that happens around the time of the default triggers the default and the reduction in credit. Third, recent econometric literature has shown that standard TWFE estimators can yield biased estimates in the presence of heterogeneous treatment effects across groups and over time (e.g., De Chaisemartin and d'Haultfoeuille, 2020; Callaway and Sant'Anna, 2021). This is because the TWFE estimator, in aggregating treatment effects, can include "forbidden comparisons".

To address all three shortcomings, we again turn to a dynamic event-study framework. More specifically, we integrate Poisson regressions into the local-projections-DiD framework (Jordà, 2005; Dube et al., 2025) while examining the data at two levels of aggregation. This tractable approach allows us to trace out the year-by-year impact of default, test for pre-existing trends, and understand both the aggregate effects and the underlying mechanisms.

We first estimate the aggregate impact at the debtor level for each horizon h from ten years before to twenty years after the default event:

$$M_{i,t+h} = \exp\left(\beta_h^{agg} \Delta D_{it} + \alpha_i^{(h)} + \gamma_t^{(h)}\right) \times \epsilon_{i,t+h}^{(h)}$$

where D_{it} is an absorbing indicator equal to one in all years after sovereign i has defaulted, ΔD_{it} is the first difference thereof, and we include debtor fixed effects ($\alpha_i^{(h)}$) and year fixed effects ($\gamma_t^{(h)}$). This specification captures the overall evolution of sovereign borrowing following default.

We then estimate a more granular specification at the debtor-creditor level:

$$M_{i,j,t+h} = \exp\left(\beta_h^{micro} \Delta D_{it} + \theta_{ij}^{(h)} + \delta_{jt}^{(h)}\right) \times \epsilon_{i,j,t+h}^{(h)}$$

where $\theta_{ij}^{(h)}$ are debtor-creditor fixed effects and $\delta_{jt}^{(h)}$ are creditor-year fixed effects to additionally absorb static debtor-creditor-relationships characteristics, and time-varying shocks to creditors' overall lending capacity, comparing how a specific creditor's lending to the defaulting sovereign changes relative to its lending to other sovereigns in the same year. [10]

Panel A and B of Figure 9 present the results. Both plot the estimated coefficients, β_k, for each year k from ten years before to ten years after a default event, along with their 95% confidence intervals. The year prior to the default ($k = -1$) serves as the omitted baseline category. The two specifications further show no evidence of systematic pre-trends, with point estimates close to zero and statistically insignificant in the pre-default period. At default ($h = 0$), both reveal an immediate contraction of approximately 30%. The penalty intensifies dramatically over subsequent years, reaching maximum severity around year four with contractions exceeding 80% in both specifications.

The recovery patterns, however, reveal important differences between the two specifications. At the debtor-creditor and creditor-year level (Panel B of Figure 9), recovery begins after year four, and coefficients become statistically insignificant soon after, suggesting that at least for some sovereigns, existing relationships eventually normalize. In contrast, the debtor-level results (Panel A of Figure 9) show much more persistent penalties, with credit flows remaining approximately 75% below pre-default levels even after a decade.

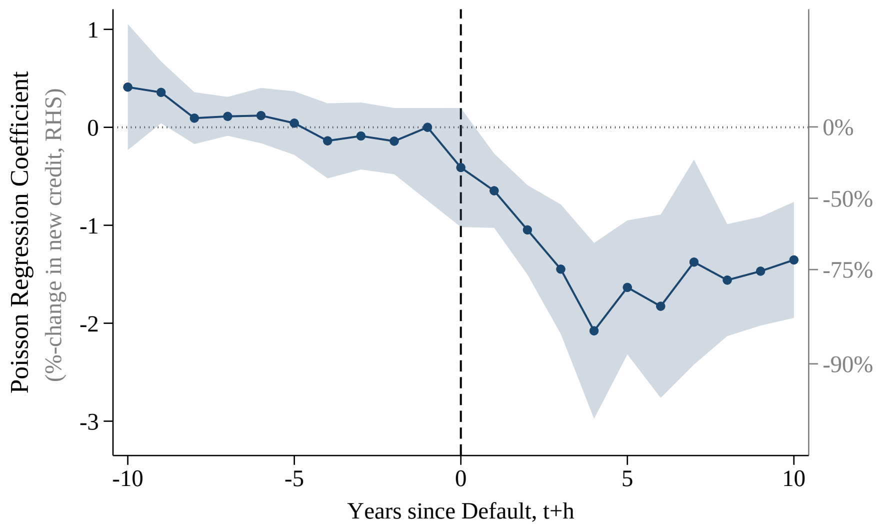
This divergence in recovery patterns admits two complementary interpretations. From an *econometric* perspective, the debtor-creditor specification provides cleaner estimation, since the inclusion of highly granular debtor-creditor and creditor-year fixed effects absorbs any relationship specific and time-varying creditor-specific shocks. For instance, if an international bank broadly retreats from emerging markets following a wave of defaults. The debtor-level specification cannot separate such coincident credit market shifts from the effect of an individual sovereign's default. This suggests that some of what appears as persistent default penalties at the aggregate level may reflect broader changes in global credit conditions rather than the pure default effect. Since Panel B is estimated at the debtor-creditor level, the difference moreover hints at a "two-speed recovery" in sovereign credit markets. The faster recovery at the debtor-creditor level indicates that surviving relationships eventually return to pre-default levels, as creditors who weather the restructuring process and maintain engagement gradually restore their original lending patterns. The persistently depressed aggregate credit, even as existing relationships recover, suggests that new creditor entry at the extensive margin is much slower.

This finding connects directly to our earlier evidence on creditor base erosion (Section 4.1). The combination of high creditor exit rates and persistently deterred entry means that defaulting sovereigns become trapped in a segmented market. They must rely on a smaller pool of specialized distressed debt investors, unable to access the broader universe of creditors even after their existing relationships have normalized.

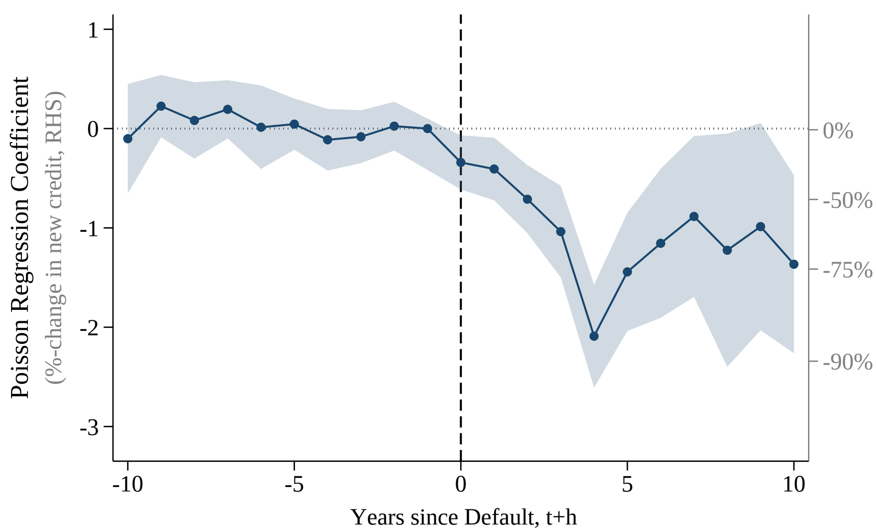
[10] Since creditors who cease lending are recorded as zeros rather than missing values until they stop lending to any sovereign, this analysis captures both the intensive margin (reduced lending amounts) and the extensive margin of existing creditor exit (relationships dropping to zero). However, it cannot capture deterred entry by creditors who never establish a relationship due to the default. Potential entrants who are deterred by the default never appear in the data, making it impossible to estimate debtor-creditor fixed effects for these never-realized relationships.

Figure 9: Credit Contraction with Local Projections Diff-in-Diff

Panel A: Contraction in new credit at the debtor-level



Panel B: Contraction in new credit at the debtor-creditor level



Notes: This figure shows local projections diff-in-diff regressions of new credit on an absorbing default indicator in an unbalanced panel between 1970–2020. Panel A reflects 5 465 sovereign-year observations with 54 default episodes in a subset of 116 debtor countries. Panel B reflects 198 416 creditor-sovereign-year observations across 7 486 debtor-creditor pairs, and 54 default episodes in 116 debtor countries, equivalent to 3 630 default episodes at the debtor-creditor level. The horizontal axis shows years before and after default events as measured by Asonuma and Trebesch (2016). Regressions include creditor-year and debtor-creditor fixed effects. Blue dots show point estimates and blue shaded areas indicate 95% confidence intervals clustered at the debtor-creditor pair level. The year prior to default is omitted to allow for the interpretation of relative changes.

This figure shows local projections diff-in-diff regressions of new credit at the debtor level, on an absorbing default indicator in an unbalanced panel of 5 465 sovereign-year observations with 54 default episodes in a subset of 116 debtor countries, between 1970–2020.

4.4 Borrowing costs

The previous sections documented substantial and persistent contractions in credit volumes following sovereign default. One question inevitably arises: do these quantity effects come alongside increases in borrowing costs? The empirical literature on default and borrowing costs reveals a striking lack of consensus on this question, with studies finding no lasting effects, small persistent effects of around 20 basis points, or large temporary effects that decay rapidly (for reviews, see Borensztein and Panizza, 2009; Cruces and Trebesch, 2013). Borensztein and Panizza (2009) find initial spread increases of 400 basis points immediately post-default that become insignificant within two years, concluding that "investors react strongly but have very short memory."

In this section, we revisit the findings of this literature in our micro data. A key difference to existing studies is that we observe the terms of primary market pricing, whereas the literature has predominantly focused on the reactions of secondary market spreads. While secondary market spreads provide valuable information about investor sentiment and perceived default risk, they do not directly measure the cost at which sovereigns can obtain new financing. It is primary market pricing –the terms negotiated for new loan origination and bond issuances – that determines the actual borrowing costs facing sovereigns seeking to access credit markets.

Before presenting our evidence, we note important data limitations that constrain our analysis of borrowing costs. First, we cannot observe the full set of contractual terms that determine the true cost of credit, including collateralization requirements, covenants, and other non-price terms that may tighten considerably post-default. Second, we observe coupon rates but cannot directly determine whether bonds are issued at par, at a premium, or at a discount. If bonds are systematically issued below par in the post-default period, the coupon rate would understate the true yield to maturity and hence the borrowing cost. Third, and relatedly, our data on nominal coupon payments cannot be straightforwardly converted into expected returns without additional assumptions about default probabilities and recovery rates. These limitations mean our analysis provides only a partial view of the full price dimension of credit market access.

Notwithstanding these caveats, we examine trends in contractual interest rates using local projections difference-in-differences analysis. As before, we estimate

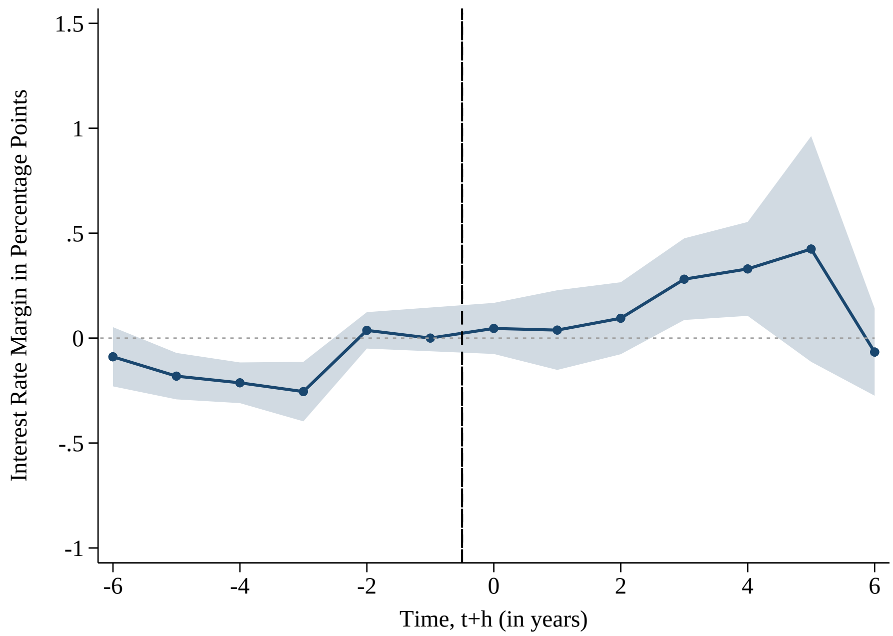
$$\text{Spread}_{i,j,t+h} - \overline{\text{Spread}}_{i,j,pre} = \beta_h \Delta D_{it} + \delta_{jt}^{(h)} + \epsilon_{i,j,t+h}^{(h)}, \quad h = -6, \ldots, 0, \ldots, 6$$

where the dependent variable, is the interest rate spread that sovereign i pays over the reference rate to creditor entity j, $Spread_{i,j,t+h}$, relative the average of the same measure prior to the default, $\overline{\text{Spread}}_{i,j,pre}$.[11] In addition to creditor-year fixed effects (which con-

[11] To ease comparison over time and across loans, we focus on the subset of variable-interest rates loans for which terms are most directly comparable. Typically, the interest rates on these instruments consists of a reference rate such as LIBOR to account for general macroeconomic and financial conditions and a country-specific spread.

trol for global changes in the pricing of a given creditor), the specification also absorbs debtor-creditor-pair specific pricing via the first-difference, which absorbs all time-invariant characteristics of lending relationships. All other notation follows Section 4.3.

Figure 10: Borrowing costs after default



Notes: This figure shows point estimates and 95% confidence intervals from local projections diff-in-diff regressions with creditor-year fixed effects in an unbalanced panel of 10 018 creditor-sovereign-year observations across 3 204 debtor-creditor pairs, and 54 absorbing default episodes in 116 debtor countries, equivalent to 3 630 default episodes at the debtor-creditor level, between 1970–2020. Vertical bars indicate 95% confidence intervals clustered at the debtor level. The year prior to default ($h = -1$) is omitted to allow for the interpretation of relative changes.

Figure 10 shows a small but statistically significant increase in borrowing costs within debtor-creditor pairs after default. We observe interest rate increases of approximately 30-40 basis points in years 3-5 post-default. These short-lived increases in borrowing costs in Figure 10 are in line with findings in the existing literature on secondary market spreads. The magnitude of increases, however, are substantially smaller than those documented in the literature: Our estimates of 20-40 basis points contrast sharply with Borensztein and Panizza (2009)'s finding of 400 basis point secondary market spread increases in the year following default. In secondary markets, the supply of bonds is fixed in the short run, so market clearance must occur via price adjustments when investor demand shifts. A flight from sovereign debt thus manifests entirely as spread widening. In contrast, our primary market data capture settings where both price and quantity can adjust simultaneously. When credit supply curves shift leftward and become steeper after default – reflecting both the loss of creditors and reduced willingness of remaining creditors to expand lending – sovereigns face a choice between accepting higher borrowing costs or reducing their borrowing.

Our evidence suggests sovereigns opt for the latter, consistent with price-elastic credit demand. If sovereign borrowers faced supply curve shifts with perfectly inelastic demand (i.e. vertical demand curves), we would observe large price increases but limited quantity responses. Instead, we document the opposite: massive quantity contractions (Section 4.3) but relatively muted price effects. Sovereigns appear to sharply curtail new borrowing rather than paying dramatically higher rates, particularly given that high borrowing costs may signal distress and trigger adverse feedback loops (Calvo, 1988). The modest primary market spread increases we document thus reflect equilibrium outcomes where quantities absorb much of the adjustment, not an absence of supply-side penalties.

Two additional factors may contribute to the muted price effects we observe. First, our analysis of interest rates necessarily conditions on observing a loan—that is, on the sovereign and creditor reaching an agreement. The severe credit contractions documented in Section 4.3 imply that many potential lending relationships do not result in new credit after default. We may thus be observing the lower tail of the distribution of potential borrowing costs, with prohibitively expensive credit never appearing in our data because sovereigns rationally decline such offers, or creditors ration it (Stiglitz and Weiss, 1981). Second, the compositional shift toward specialized distressed credit providers documented in Section 4.2 may obscure the full cost increase. These creditors may extract rents through channels other than stated interest rates—including fees, collateralization, and covenant restrictions we cannot observe (Gelpern et al., 2023) – causing our analysis to understate the true increase in borrowing costs.

5 A Model of Sovereign Default with Heterogeneous Creditors

Our empirical findings challenge the assumptions and findings of classic representative agent sovereign debt models (e.g. Arellano, 2008), which typically assume a representative creditor, full market exclusion post-default, and short-lived economic consequences with minimal scarring. Indeed, in Appendix D.1, we show that when calibrating a standard model with our new estimates of market exclusion, sovereigns can hardly sustain any debt, and choose to default most of the time. This is despite the existence of additional, direct output costs in these models. Since direct output costs are assumed to last as long as the government is excluded from the market, short market exclusion duration also mutes the output cost channel (Arellano, 2008). Finally, the standard models do not capture the observed dynamics of partial credit access, selective creditor withdrawal, and persistent borrowing constraints driven by both intensive and extensive margins.

To rationalize the empirical findings, we instead develop a qualitative reputation-based model featuring heterogeneous creditors and segmented markets adapting elements from the model class developed by Amador and Phelan (2021, 2023) and Clayton et al. (2024, 2025). Our model positions creditor heterogeneity and fragmented markets as fundamental in shaping borrowing and market access, and thus as the costs of default. Following a default, sovereigns retain access to creditors with lower reputation thresholds, enabling partial borrowing capacity, while higher interest rates and reduced volumes reflect shifts in credit supply (or debt security demand) elasticities. By microfounding these market responses, the model rationalizes why sovereigns can rebuild reputation through selective borrowing in private markets, a mechanism absent in traditional frameworks. Moreover, the model highlights how creditor heterogeneity fundamentally shapes sovereign borrowing conditions and default incentives.

In our framework, following an older reputation-cycle literature (Phelan, 2006; Barro, 1986; Kreps and Wilson, 1982; Milgrom and Roberts, 1982), rounds of a repeated game consist of governments borrowing from fragmented private credit markets in which creditors exhibit diverse preferences for holding sovereign debt and thus heterogeneous responses to default. The repetitive nature of the game, allows debtors whose nature is unknown to all other market participants to build reputation over time, by repeatedly choosing to repay, rather than default. This is in line with the work of Fourakis (2021) that shows how creditors learn about debtor types by observing the latter's actions. We show that in such an environment with dynamic reputation building, the model's dynamics mirror the empirical regularities documented in the empirical section of this paper, including the absence of market exclusion following default. Specifically, the model provides a causal micro-foundation where the unobservable state variable of reputation drives the observable sorting of creditors and the persistent reduction in credit access. In line with the empirical patterns, there is creditor sorting in the model. Some lenders withdraw, while others continue lending, as determined by reputation preferences. Access to credit is reduced—driven by some creditors temporarily withdrawing from lending while others reduce exposure along the intensive margin. In the data total market exclusion is atypical and indeed the model concurs: We show that in this class of models, complete market exclusion is impossible in equilibrium. This is because market exclusion would mean no borrowing and hence a zero probability of default, which in turn implies the highest reputation level and thus positive borrowing.

5.1 Stage Game

We consider a discrete-time, infinite-horizon setting where $t = 0, 1, 2, \dots$. Each period consists of two phases: Beginning and End. The model features one sovereign borrower with a risk-neutral government and a continuum of creditors distributed across a continuum of observable types $i \in [0, 1]$. At each period's start, the government exists in one of two possible states: committed or opportunistic. This state remains unobservable to creditors. Between periods, governments may experience regime change: a committed (opportunistic) government transitions with probability ϵ_C (ϵ_O). At the Beginning phase of period t, the government determines its borrowing amount from each creditor type. At the end of the period, the government decides whether to default and impose a haircut $\tau_t \in \{0, \bar{\tau}\}$ on repayments to creditors. By definition, a committed government never defaults ($\tau_t = 0$ always), whereas an opportunistic government makes this choice strategically. [12]

5.1.1 Government Payoff

At the inception of date t, the government possesses the capacity to secure a loan, $D_t^i \geq 0$, from creditors of type $i \in [0, I]$, at an endogenously determined interest rate R_t. The capital thus acquired is subsequently allocated to productive assets, which are projected to yield a risk free expected return of Q per unit of investment. Let the aggregate governmental indebtedness be denoted as $D_t = \int_0^I D_t^i di$. At the conclusion of date t, the government exercises its prerogative to either impose or abstain from imposing a haircut, $\tau_t \in \{0, \bar{\tau}\}$, on the principal repayment due to creditors. This decision directly influences its stage game payoff, expressed as:

$$c_t = g(\tau_t)[(Q - R_t)D_t], \tag{7}$$

where $g(\bar{\tau}) > g(0) = 1$. We shall define $g(\bar{\tau}) = 1 + \frac{\bar{\tau}}{(Q - R_t)}$, so that the benefit of defaulting equals $\bar{\tau}D$. [13]

[12] Including a committed government in this type of model thereby circumvents the Bulow-Rogoff paradox (Bulow and Rogoff, 1989) by generating equilibrium debt without requiring the presence of direct default penalties. A deeper investigation whether creditor heterogeneity (including differences in enforcement technology) can potentially bridge the direct-cost and reputation literature will be left to future research.

[13] For simplicity, the functional form of $g(\tau)$ assumes defaults involve haircuts on the nominal but full payment of coupons / interest.

5.1.2 Creditor Investment Decision

Each type-i creditor makes portfolio allocation decisions at the beginning of period t based on their initial wealth w^i. Creditors face two investment alternatives:

- Sovereign debt D_t^i offering the promised interest rate R_t
- An outside investment opportunity yielding exogenous return $\bar{R}$[14]

At the period's start, creditors share a common assessment $M_t \in [0, 1]$ representing the probability that the government will refrain from defaulting. We refer to M_t as the government's reputation at time t. Each creditor i solves the following optimization problem:

$$\max_{D_t^i} \bar{R}w^i + [R_t \mathbb{E}[1 - \tau_t] - \bar{R}]D_t^i - \frac{b}{2} \frac{D_t^{i\ 2}}{\omega_i(M_t)}. \tag{8}$$

The expression consists of expected monetary returns from the creditor's investments (first two terms) and a utility holding cost (final term). The parameter b affects the demand curve's slope. $\omega_i(M_t)$ represents a creditor-specific taste function that increases weakly with M_t and features a threshold M_i below which a creditor does not lend at all. We define the creditor-specific willingness function $\omega_i(M)$ as follows:

$$\omega_i(M) = \begin{cases} 0 & \text{if } M < M_i \\ (M - M_i) & \text{if } M \geq M_i \end{cases} \tag{9}$$

This definition captures that creditors have varying minimum reputation requirements for participation in the sovereign debt market. We assume that M_i follows a continuous distribution over $[0, 1)$ with cumulative distribution function $F(M_i)$ and probability density function $f(M_i)$. As we will show, the support on $[0, 1)$ (ensuring $\min_i M_i = 0$) must be assumed for equilibrium consistency. [15]

$\omega_i(M_t)$ serves to capture the heterogeneity in creditors' preferences for holding sovereign debt at different reputation levels. Creditors with higher ω_i values face lower holding costs for government debt at any given reputation level. The key feature of this threshold-based definition is that at any given reputation level M_t, only creditors with $M_i \leq M_t$ participate in the debt market. This engenders a selective participation effect that fragments the debt markets and causes dynamics in line with the data that are fundamentally different compared to a setting where all creditors participate at all reputation levels.

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[14] For any borrowing to occur, we must assume $Q > \bar{R}$.

[15] Note that when $M_t < M_i$, we have $\omega_i(M_t) = 0$, and for $D_t^i > 0$, the holding cost $\frac{b}{2} \frac{D_t^{i\ 2}}{\omega_i(M_t)}$ is undefined. However, approaching the undefined region in the optimization, the holding cost approaches $+\infty$ in the limit, rendering any positive investment suboptimal as the objective function extends to $-\infty$ on the extended real line for any $D_t^i > 0$.

5.1.3 Creditor Demand Schedule

From the creditor's first-order condition with respect to D_t^i, the equilibrium interest rate satisfies:[16]

$$R_t = \frac{\bar{R} + \frac{bD_t^i}{\omega_i(M_t)}}{1 - (1 - M_t)\bar{\tau}} \tag{10}$$

Equation 10 describes the cost of borrowing a government faces, via the demand curve's for its debt. The demand elasticity declines (i.e. the demand curve's slope steepens) with both the loss given default, set by $\bar{\tau}$; and the holding cost parameter b, meaning a higher cost of borrowing, holding the amount of credit constant. Conversely, the demand curve flattens, when the probability of the government being committed, M_t, increases, leading to lower borrowing costs, ceteris paribus.

Solving for D_t^i, results in the creditor's demand schedule. For creditors with $M_i \leq M_t$, this yields:

$$D_t^i = \frac{\omega_i(M_t)}{b}[R_t(1 - (1 - M_t)\bar{\tau}) - \bar{R}] \tag{11}$$

Conversely, for creditors with $M_i > M_t$, we have $D_t^i = 0$ since their $\omega_i(M_t) = 0$. The equation underscores that creditors with higher $\omega_i(M_t)$ purchase larger quantities of debt at any given interest rate and reputation level.

5.1.4 Debt Market Equilibrium

Market clearing requires that aggregate demand equals supply:

$$D_t = \int_{i:M_i \leq M_t} D_t^i di = \int_{i:M_i \leq M_t} \frac{\omega_i(M_t)}{b}[R_t(1 - (1 - M_t)\bar{\tau}) - \bar{R}]di \tag{12}$$

Substituting the market clearing condition into the demand function then allows us to solve for the equilibrium interest rate:

$$R_t = \frac{\bar{R} + \frac{bD_t}{\Omega(M_t)}}{1 - (1 - M_t)\bar{\tau}} \tag{13}$$

Where for notational simplicity, we define

$$\Omega(M_t) = \int_{i:M_i \leq M_t} \omega_i di$$

[16]Note that the expected haircut is $\mathbb{E}[\tau_t] = (1 - M_t)\tau$, so $\mathbb{E}[1 - \tau_t] = 1 - (1 - M_t)\tau$

5.1.5 Committed Government Optimal Borrowing Strategy

The committed government maximizes its current-period payoff, taking reputation M_t as given, and without strategically considering its decisions on the behavior of mimicking opportunistic governments:

$$\max_{D_t}(Q - R_t)D_t \tag{14}$$

The government internalizes how its issuance affects the interest rate, acting as a monopolist in its debt market.

Lemma 1 *The optimal borrowing strategy for a committed government is:*

$$D_t^* = \frac{\Omega(M_t)(1-(1-M_t)\bar{\tau})}{2b}\left[Q - \frac{\bar{R}}{1-(1-M_t)\bar{\tau}}\right] \tag{15}$$

The lemma establishes the dependency of the committed government's borrowing strategy on its reputation, M_t. The government extends a uniform interest rate determined by its reputation level, $R(M_t)$, to all creditors. Higher reputation, M_t, increases debt issuance through two channels: more creditors participate (higher $\Omega(M_t)$) and lower default risk improves borrowing conditions. The optimal debt formula therbey also reflects the government's monopolistic power: when issuing additional debt, the government must account for how this affects the interest rate on its entire debt stock. This gives rise to the classic monopolist behavior of restricting quantity to secure more favorable prices. See Appendix D.3.2 for the derivation.

5.1.6 Opportunistic Government Strategy

Because the opportunistic government's payoff is a function of the committed government's payoff function, we first define the committed government's period payoff as:

$$V(M_t) = (Q - R_t)D_t \tag{16}$$

An opportunistic government mimics the committed government's borrowing strategy to avoid revealing its type. Additionally, it decides whether to impose the haircut $\tau_t \in \{0, \bar{\tau}\}$. The opportunistic government's period payoff as a function of its reputation M_t and haircut τ_t is:

$$V^{Opp}(M_t, \tau_t) = g(\tau_t)V(M_t). \tag{17}$$

The opportunistic government's strategy $m_t^o(\pi_t) \in [0,1]$ denotes the probability of not imposing the haircut, depending on beginning-of-period creditor beliefs π_t about the government's type. Creditors form beliefs $m_t(\pi_t)$ about the probability an opportunistic government will not default, resulting in reputation $M_t = M_t(\pi_t) = \pi_t + (1-\pi_t)m_t(\pi_t)$.[17]

The opportunistic government's value function must then satisfy the Bellman equation:

$$\begin{aligned} W_t(\pi_t) = \max_{m_t \in [0,1]} \{ & m_t[V^{Opp}(M_t(\pi_t), 0) + \beta W_{t+1}(\pi_{t+1})] \\ & + (1-m_t)[V^{Opp}(M_t(\pi_t), \bar{\tau}) + \beta W_{t+1}(\epsilon_O)]\} \end{aligned} \tag{18}$$

For a mixed strategy equilibrium, the opportunistic type must be indifferent between defaulting and repaying. This indifference condition requires:[18]

$$W_{t+1}(\pi_{t+1}) = \frac{1}{\beta}[g(\bar{\tau}) - 1]V(M_t(\pi_t)) + W_{t+1}(\epsilon_O) \tag{19}$$

This highlights that an opportunistic government only passes on the immediate benefit of defaulting if it receives sufficient future value from the resulting improvement in creditor beliefs about its type.

5.2 Dynamic Game and Equilibrium

5.2.1 Belief Updating and Reputation Dynamics

After each period's payoffs are realized, the government may undergo a regime change. These transitions remain unobservable to creditors, though they know the probability distribution. A committed (opportunistic) government experiences regime change with probability ϵ_C (ϵ_O), where $\epsilon_C + \epsilon_O < 1$. All governments discount future payoffs at rate $\beta^* < 1$ but assign no value to outcomes after a regime change. We define $\beta = \beta^*(1-\epsilon_O)$.

Creditor beliefs evolve via Bayes' rule. Following repayment, posterior beliefs (which become beginning-of-next-period prior beliefs) are:

$$\pi_{t+1} = \epsilon_O + (1 - \epsilon_C - \epsilon_O)\frac{\pi_t}{M_t(\pi_t)} \tag{20}$$

Following default, beliefs reset: $\pi_{t+1} = \epsilon_O$, accounting for the possibility of regime change. The derivation from Bayes' rule, accounting for regime change probabilities, is provided in Appendix D.3.3.

[17] For notational clarity, we at times suppress the dependency on π_t.

[18] See Appendix D.3.4 for the derivation.

5.2.2 Equilibrium Concept

We focus on Markov strategies for both committed and opportunistic governments that depend only on creditor beliefs π_t.

Definition: An equilibrium consists of: committed government debt issuances $\{D_t^i\}$, creditors' debt purchases $\{D_t^i\}$ clearing markets at interest rates $\{R_t\}$, opportunistic government strategies $m_t^o(\pi_t)$, creditor beliefs $\{\pi_t\}$, government reputation $\{M_t(\pi_t)\}$ and the aggregation function $\Omega(M_t)$ such that: (1) Debt issuances maximize committed government payoffs; (2) Debt purchases maximize creditor payoffs subject to the participation condition $D_t^i = 0$ whenever $M_t < M_i$; (3) $m_t^o(\pi_t)$ maximizes opportunistic government payoffs at each t; (4) π_t evolves according to Bayes' rule; (5) Creditor beliefs align with opportunistic government strategies; (6) $m_t(\pi_t) = m_t^o(\pi_t)$; (7) the distribution of thresholds M_i is given by $F(\cdot)$ with density $f(\cdot)$, and $\Omega(M_t) = \int_{i:M_i \leq M_t} \omega_i, di$ is positive, finite and weakly increasing for all M_t.

5.3 Theoretical Results

5.3.1 On-Path Impossibility of Total Exclusion

A key characteristic that to date has found little attention in the literature on this model class is the absence of total market exclusion in equilibrium. As described above, we assume creditor thresholds M_i to be distributed over $[0, 1)$ such that $\min_i M_i = 0 < \epsilon_O$, ensuring partial access at any reputation $M_t > 0$. This is not an arbitrary assumption but in fact dictated by the model: on-path total exclusion cannot arise, as anticipating zero borrowing lets a sovereign reach full reputation $M_t = 1$, mechanically, since default is impossible, hence unlocking lending by all creditors.

Proposition 1 *In any equilibrium, total exclusion ($D_t = 0$) cannot occur on-path for $\pi_t > 0$. Equilibria thus require $\min_i M_i < \epsilon_O + (1 - \epsilon_O)m(\pi_t = \epsilon_O)$.*

The argument proceeds by contradiction. Suppose creditors expect on-path exclusion with $D_t = 0$ following default when beliefs reset to $\pi_t = \epsilon_O > 0$. With zero debt, the opportunistic type faces no stage-game trade-off between defaulting and repaying—both yield identical current payoffs. The decision is therefore driven entirely by continuation values. Not defaulting improves beliefs and hence future reputation, while defaulting resets beliefs to ϵ_O. Since the value function $W(\pi)$ is strictly increasing in beliefs (higher beliefs generate better borrowing terms), the opportunistic type strictly prefers not to default, yielding $m_t(\pi_t) = 1$. This implies reputation jumps to $M_t = 1$, which in turn induces positive supply from all creditors and positive optimal borrowing by the committed type. The opportunistic type mimics this strategy, contradicting the initial assumption of zero debt issuance. See Appendix D.2 for the formal proof.

This result reveals a self-defeating prophecy inherent to total exclusion. If creditors were to fully exclude the sovereign, the opportunistic type would strictly prefer not to default on zero debt. But creditors, anticipating $m_t = 1$, would assign maximum reputation, inducing full participation and positive lending—contradicting the initial exclusion assumption. This mechanism ensures that partial market access must persist even at the lowest on-path reputation levels.

5.4 Model Simulation

After having established key properties of the model, we now turn to a numerical illustration to show how creditor heterogeneity shapes sovereign borrowing conditions post default. The model's simulations demonstrate how the selective withdrawal of creditors fundamentally alters the sovereign's credit supply curve, leading to the observed post-default borrowing equilibria characterized by quantity-based adjustments. For the numerical implementation, we discretize the continuous distribution of M_i into a finite number of creditor types. With a uniform distribution on $[0, 1]$, we use:

$$M_i = \frac{i-1}{n-1} \quad \text{for } i = 1, 2, \ldots, n \tag{21}$$

Each creditor type has equal mass $\frac{1}{n}$. Further, we approximate the aggregate preference parameter as:

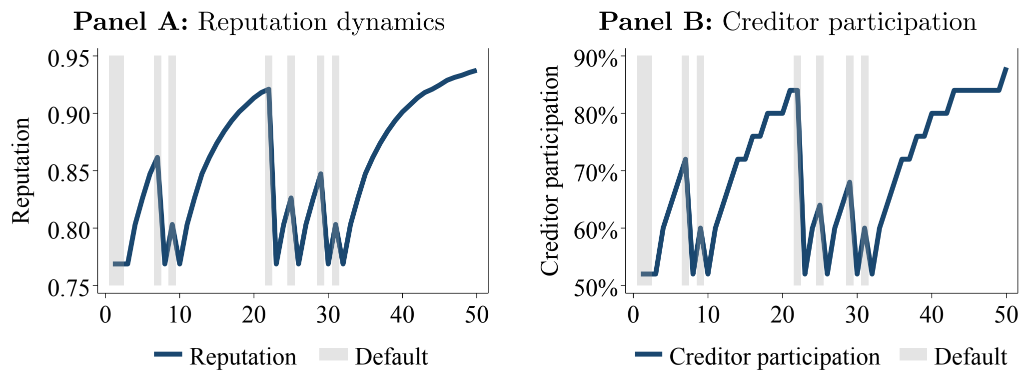
$$\Omega(M_t) \approx \frac{1}{n} \sum_{i: M_i \leq M_t} (M_t - M_i) \tag{22}$$

This discretization allows for the numerical computation of all model quantities while preserving the key features of the continuous threshold distribution. The illustrative numerical simulation, spanning 50 periods, tracks the evolution of critical variables such as debt issuance, interest rates, and the fraction of active creditors. The model is designed to be qualitative, providing a unified theoretical framework that generates and explains the features of the data, rather than quantitatively matching specific moments. Specifically, the model illustrates how the unobservable state variable of reputation, M_t, drives all dynamics in the observable variables in a way that mirrors those described in the empirical section, providing a unified theoretical explanation for our empirical findings in Section 4.

5.4.1 Creditor Erosion and Market Fragmentation

In the model, we posit that *reputation* (M_t) is the key determinant of the credit supply shifts we document in section 4. Reputation, however, cannot be directly observed in the data, which is why we exclusively rely on the model's simulation, without an empirical pendant. Figure 11, Panel A, illustrates the cyclical nature of the sovereign's reputation (M_t). Following a default (shaded areas), reputation resets to a low level, driven by $\pi_t = \epsilon_O$, and then gradually rebuilds through consistent repayment. This slow, dynamic process is the engine that generates the persistent post-default effects.

Figure 11: Model simulations: Reputation, creditor participation and borrowing conditions



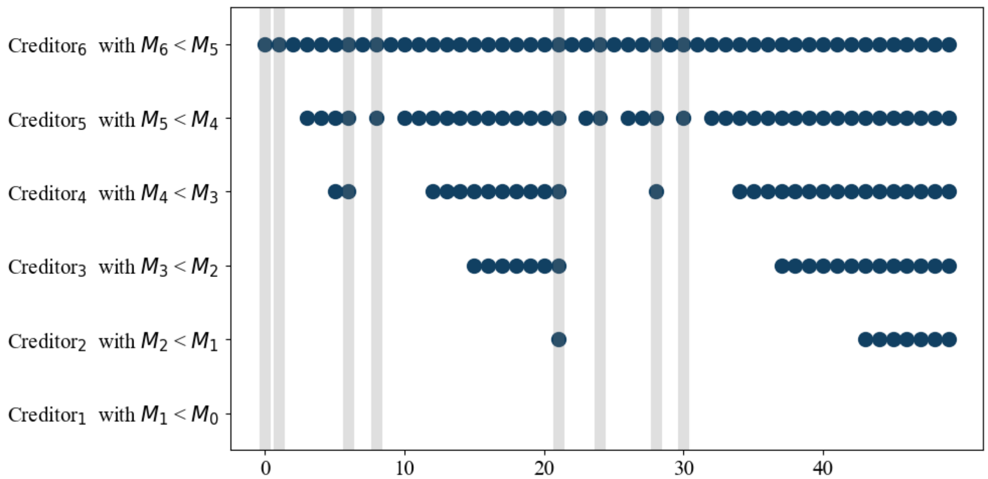
Notes: This figure shows model simulation results over 50 periods, with the creditor space discretized over 25 different values of M_i. Panel A shows the sovereign's reputation level M_it, and Panel B shows the share of creditors that are lending to sovereign i. Grey shaded areas indicate default episodes.

The most direct link between the model and our empirical findings is the mechanism of creditor erosion and market fragmentation: In Section 4.1, we document that at least half of a sovereign's creditors withdraw post-default. The model directionally replicates this through the threshold-based participation condition, $\omega_i(M_t)$ (Equation 9), where creditors with high reputation thresholds (M_i) exit the market when M_t falls below their minimum requirement.

Panel B of Figure 11 mirrors the empirical finding. The fraction of active creditors drops sharply following default events (indicated by gray shaded vertical lines) but never falls to zero, consistent with our empirical finding that some creditors typically continue to lend after a default. The sharp drop in the share of participating creditors post-default is thereby driven by the exit of high-threshold creditors. The slow recovery of this share over time provides a theoretical explanation for the persistent reduction in the depth of the creditor base. Although reaccess to some credit is immediate, a direct consequence of slow reputation building is the gradual re-entry of creditors as reputation recovers $\Omega(M_t)$.

Figure 12 provides a more granular view of this selective participation in the model. High-threshold creditors (e.g., Creditor$_3$) immediately withdraw and only re-enter when reputation is sufficiently restored, while low-threshold creditors (e.g., Creditor$_6$) continue to lend. This sorting mechanism provides a micro-foundation for our empirical finding that defaulters rely on a narrower set of counterparties, often distress specialists. The illustration in Figure 12 also highlight the heterogeneity in lending behavior, and response to default, with some creditors lending consistently across periods, while others participate only sporadically, underscoring the threshold-driven diversity that is central to the model.

Figure 12: Creditor participation over time



Notes: This figure shows the modeled lending by different creditors over time. Model simulation results stem from 50 simulated periods, with the creditor space discretized over 25 different values of M_i.

This selective participation is the theoretical counterpart to our empirical finding in Section 4.2 that the weighted creditor preference rank drops by 20 percentile points post-default. The model suggests that the drop in the average rank is caused by the exit of high-rank (high-M_i) creditors, leaving the sovereign to borrow from a pool dominated by low-rank (low-M_i) creditors. This mechanism explains why a country like Brazil, following its 1982 default, was forced to rely on a more specialized, higher-risk-appetite group of creditors for years, a pattern that is structurally consistent with the model's prediction of a market fragmented by reputation thresholds. The model thus provides a link between the unobservable drop in reputation and the measurable shift in the composition of the creditor base.

In Section 4.2.1 we further documented that unlike the broader market, bond markets indeed exclude the defaulter for extended periods of time. Our model can also reproduce this result: A key distinction between private creditors (including banks) and bond investors lies in the regulatory constraints that many bond investors face. While all creditors (banks and bond) observe the same π_t and form identical beliefs about $M_t = \pi_t + (1 - \pi_t)m_t(\pi_t)$, in the appendix we assume that bond investors are subject to investment-grade mandates that prevent participation unless M_t exceeds a *Bond Market Threshold*. Such mandates are in fact common and can be explained by frameworks like that of Diamond (1991, 1984), recognizing that bond investors face higher screening and verification costs compared to private creditors, which in turns renders riskier instruments less attractive. With that additional assumption, we show in Appendix D.4 that the model can simultaneously feature partial access to the broader market, and full exclusion from bond issuance.

5.4.2 Borrowing Quantities and Costs

The erosion of the creditor base has a direct and profound impact on the sovereign's borrowing capacity. The attrition of creditors rationalizes the empirical observation from Section 4.3 that post-default adjustment occurs primarily through quantity rather than price, supporting this non-flat, elastic supply curve structure. In the model, the same dynamic is driven by the withdrawal of high-threshold creditors, which together with higher perceived default risk, shifts and steepens the credit supply curve the sovereign faces, implying a reduced capacity to borrow for any given interest rate.

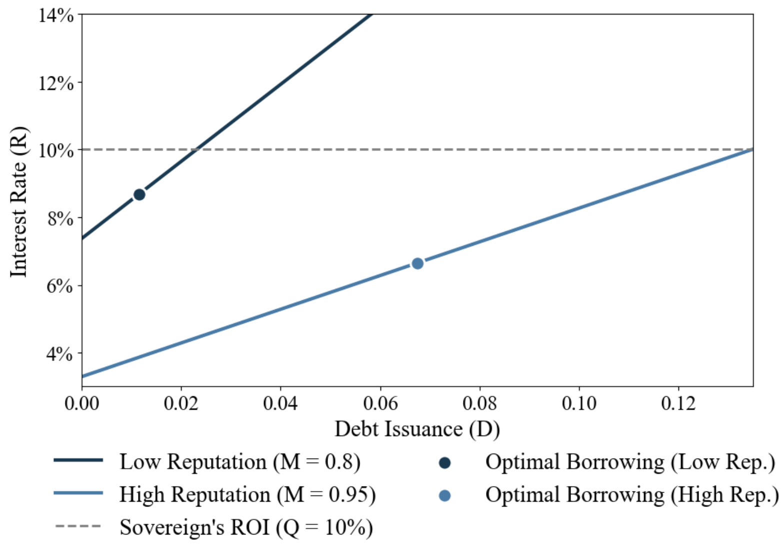
The model allows us to explicitly characterize the credit supply curve, i.e. the relationship between the interest rate (R_t) and the quantity of debt (D_t) the sovereign can issue. The core mechanism of the model is that a default shifts and steepens this curve. We can illustrate this shift by plotting the curve for a high-reputation state (pre-default) and a low-reputation state (post-default) respectively. In contrast to both market-exclusion based (Arellano, 2008) and reputation-based (Amador and Phelan, 2021) sovereign debt models, which feature a perfectly elastic (i.e. flat) credit supply curve (i.e., the sovereign is a price-taker), our model generates an upward-sloping linear supply curve whose elasticity is endogenously determined by the reputation M_t and its consequential market fragmentation.[19]

The supply curve shift in Figure 13 operates through mutliple channels. First, the default risk channel affects the expected recovery rate $(1-(1-M_t)\bar{\tau})$: as reputation falls, the higher probability of default raises both the intercept and steepens the slope of the supply curve, shifting it upward and making it less elastic to interest rate increases. Second, at the intensive margin, creditors with low enough investment thresholds to invest at all, still invest less because of a lower willingness to lend $\omega_i(M_t) = M_t - M_i$ that translates into lower debt holdings at any given interest rate. Third, at the extensive margin, the creditor participation channel operates through the aggregate preference parameter $\Omega(M_t)$: The market-clearing condition in Section 5.1.4 imposes that the set of active creditors contracts as M_t drops below successive thresholds M_i. Across the model only creditors with ($M_i \leq M_t$) hold sovereign debt, creating a fragmented market where participation contracts when reputation drops, steepening the slope of the supply curve.[20] Put differently, the slope of the supply curve, $\frac{b}{\Omega(M_t)(1-(1-M_t)\bar{\tau})}$, reflects the interaction of individual creditor holding costs (parameter b) with aggregate market structure: greater creditor participation (higher $\Omega(M_t)$) flattens the curve by spreading debt across more investors, while higher perceived default risk (lower M_t) steepens it by requiring compensation for expected losses. Thus, a reputation decline post-default operates through both channels—the default risk effect shifts the curve upward and steepens it, while creditor exit further steepens it, jointly reducing the sovereign's borrowing capacity at any given interest rate.

[19] The supply curve is linear for any given reputation M_t.

[20] Post-default, when prior beliefs reset to ($\pi_0 = \epsilon_O$), equilibrium reputation ($M_0 = \epsilon_O + (1-\epsilon_O)m_0(\epsilon_O) \geq \epsilon_O$) allows only creditors with ($M_i \leq M_0$) to lend, facilitating only restricted market access.

Figure 13: Credit supply curves before and after default

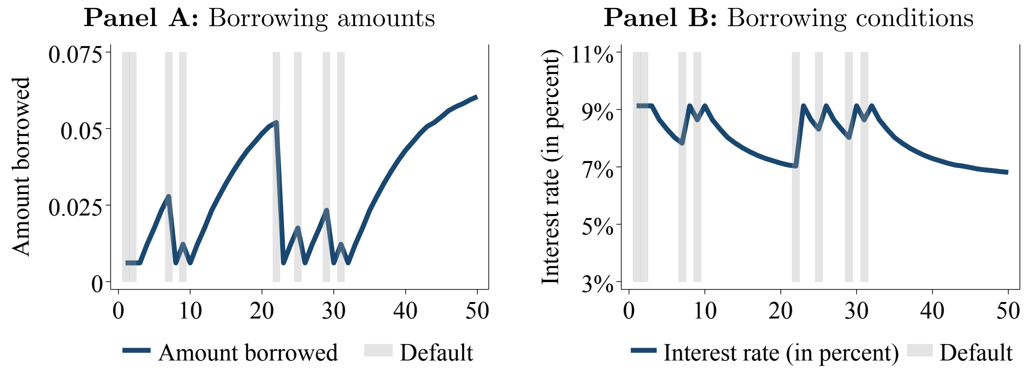


Notes: This figure shows how the credit supply curve shifts when a default triggers a drop in reputation. Because the sovereign is a monopolist in the issuance of its own debt instruments, the equilibria (dots) with high and low reputation differ along both the cost and quantity dimension, though the larger adjustment is in quantities borrowed. The gray dashed line's intersection with the credit supply curves would be the equilibria in perfectly competitive markets.

The model's optimal borrowing strategy (Lemma 1) dictates that the government, acting as a monopolist, internalizes this steeper supply curve. To maximize its current-period payoff, the government strategically restricts its borrowing quantity to secure a more favorable price. This strategic quantity restriction, combined with the less elastic supply curve, leads to the empirically observed outcome, represented as dots in Figure 13: a persistent and significant contraction in the volume of new credit (quantity adjustment), with some adjustment in prices.

Panel A of Figure 14 illustrates these equilibria over time. Immediately after a default, the borrowing quantity drops sharply and recovers very gradually, consistent with our empirical finding in Section 4.3 of a 53% contraction in new credit flows that persists for over a decade. The model thus provides a theoretical explanation for why the main adjustment channel in the data is through quantities, rather than borrowing costs.

Figure 14: Model simulations: Borrowing amounts and conditions



Notes: This figure shows model simulation results over 50 periods, with the creditor space discretized over 25 different values of M_i. Panel A shows the amount the monopolist sovereign chooses to borrow, Panel B shows the cost of borrowing, i.e. the interest rate, in percent. Grey shaded areas indicate default episodes.

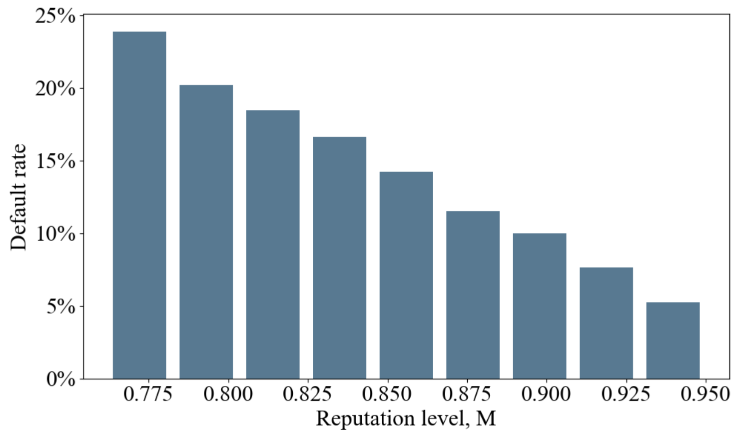
Figure 14, Panel B, shows the prevailing interest rate (R_t) over the simulation. The interest rate spikes immediately after a default due to the sharp drop in reputation (M_t) and the resulting steepening of the credit supply curve. However, as the sovereign's reputation begins to recover, the interest rate quickly drops.

The limited and temporary nature of the price adjustment is a direct consequence of the quantity-based adjustment in equilibrium we posit. Because the government acts as a monopolist (Lemma 1), it strategically restricts its borrowing volume (the quantity adjustment discussed in the previous section) to avoid pushing the interest rate too high on the now-steeper supply curve. This behavior ensures that the cost of borrowing remains contained, even as the market's risk perception has fundamentally changed.

5.4.3 Microfoundation for Serial Defaults and Debt Intolerance

Finally, the model provides an endogenous micro-foundation for the persistent risk of serial default and "debt intolerance" observed in the data. Figure 15 shows the simulated default rate as a strictly decreasing function of the sovereign's reputation, M_t, implying that the default probability is highest when reputation is low, resulting in serial defaults at low debt levels. This is a key empirical feature of sovereign debt dynamics that has eluded many standard quantitative frameworks with representative creditors and full exclusion. And while the phenomena of serial default and debt intolerance have been successfully generated in prior reputation models, notably Amador and Phelan (2021), our model provides a novel, empirically-validated micro-foundation for these outcomes. Specifically, we show that these persistent vulnerabilities are a direct consequence of the default-induced erosion of the creditor base and the resulting structural change in the sovereign's credit supply elasticity, a mechanism absent in earlier frameworks. Since default erodes the creditor base and resets reputation to a low level, the sovereign is structurally more vulnerable to future default episodes. This captures the mechanism where the long-run cost of default is not just the im-

Figure 15: Simulated Default Rates over Reputation, M



Notes: This figure shows the observed default probabilities for different reputation levels, M_t, in simulated data. The simulation is performed over 100 000 time periods.

mediate penalty, but the sustained reduction in the quality of one's creditors, which makes the sovereign structurally more vulnerable to future default episodes. The model thus provides a unified framework for understanding the full dynamic cost of sovereign default, from the micro-level decision of individual creditors to the macro-level borrowing outcomes and default frequency, including default traps and debt intolerance.

6 Conclusion

The fact that sovereigns cannot be compelled by foreign courts to repay their debts has motivated a large literature on the costs of default. This paper contributes to that literature with a novel loan-level dataset covering all 54,881 loans and bonds issued by 120 emerging markets to private creditors between 1970 and 2020. We document three main findings. First, sovereigns almost never face complete market exclusion after default. Most sovereigns reaccess credit from some private creditors within the first year, contradicting conventional estimates of multi-year exclusion periods. Second, this does not mean defaults are costless: we find that defaults are associated with a substantial erosion of the creditor base, with more than half of creditors permanently withdrawing. Sovereigns are forced to rely on a narrower pool of counterparties and increasingly borrow from distress specialists. Third, this creditor attrition, together with remaining creditors pulling back, produces sharp and persistent credit contractions exceeding 50 percent that last for more than a decade. Leveraging a model, we show how these findings point toward shifts in credit supply curves, rather than outright exclusion as the primary channel through which defaults impose costs.

Our findings suggest important implications for policy making. First, the differential exclusion patterns across creditor types suggest that preserving relationships with mainstream lenders warrants consideration in default decisions and restructuring negotiations. While some creditors may swiftly "forgive and forget," our evidence shows that many do not, meaning the composition of the creditor base at the time of default may materially affect the trajectory of market (re-)reaccess. Second, our results reveal an important complementarity across lender segments: private markets provide credit during periods of impaired reputation, while access to bond markets offers lower borrowing costs when reputation is sufficiently high. In line with the corporate finance literature on relationship lending, this pattern highlights the potential value of maintaining diverse creditor bases during normal times, as broader market access may provide resilience during episodes of distress. The stark divergence between bond markets (which impose extended exclusion) and bank lending (some of which continues throughout default) confirms just that: relationship-based private credit markets may provide insurance value when public markets are shut. These findings hence speak to ongoing policy debates about optimal sovereign debt structures and the trade-offs inherent in different financing approaches.

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Online Appendix for:

Beyond Market Exclusion: Creditor Attrition After Sovereign Default

by Clemens Graf von Luckner and Sebastian Horn

A Data

This appendix section gives a detailed explanation of all data sources used in Sections 3 and 4. We begin by giving a detailed account on how we constructed the new loan-level dataset (Section A.1 and provide sources and definitions for all other data sources in Section A.2.

A.1 Construction of the new loan-level data

The starting point for our analysis is a confidential and uniquely granular extract from the World Bank's Debtor Reporting System (DRS). Data from this system underlies the World Bank's International Debt Statistics and has been reported directly by 120 debtor countries since 1970. This Appendix Section provides details on this data source and the data construction process.

A.1.1 A primer on the World Bank Debtor Reporting System

The Debtor Reporting System is the primary source for the World Bank's external public debt statistics.[21] The World Bank requires all member countries with outstanding debt to the Bank to report detailed information on their external public and publicly guaranteed debt at the level of individual loan or bonds. This data is collected directly from the member countries – typically the ministry of finance or a central bank – and aggregated for publication through the World Bank's International Debt Statistics. The underlying loan-level data is confidential but available for researchers upon request through the Bank's Access to Information policy.

More precisely, reporting countries submit reports on the annual status of all external, long-term liabilities contracted by the public sector and by private debtors with explicit payment guarantees from the public sector. In this context, the DRS defines *external* debt as obligations of residents to non-residents, regardless of whether the obligation is denominated in foreign or domestic currency. Long-erm debt is defined as debt with an original maturity of over one year. Public sector borrowers include the central government and its departments, the central bank, local governments, public corporations, mixed enterprises in which the public sector holds more than a 50 percent share of voting power, and official development banks. At the creditor side, the DRS distinguishes between official (or government) creditors and private creditors. The latter category – on which our analysis focuses – includes bondholders, commercial banks as well as suppliers (which are not considered in our analysis).

For each transaction that fits these criteria, the reporting country provides the World Bank with data on the commitment date, the amount and currency of the loan, the name and

[21] See "World Bank (2020). Debtor Reporting System (DRS) – What it Measures" for further details and definitions.

type of the debtor, the name and type of the creditor, and the financial terms, such as the interest rate, the grace period, and the maturity date. Each year, the reporting country provides a status update that includes the outstanding debt stock for each transaction, as well as principal and interest payments.

A.1.2 Consolidating the data at the creditor entity level

In the Debtor Reporting System, creditor entity names are reported as text strings by debtor countries and the World Bank undertakes no attempt at harmonizing or standardizing creditor entities across debtors and over time. This presents a key challenge when studying the evolution of the creditor base over time, or when employing creditor entity fixed effects to isolate variation in lending *within* specific creditor entities. To ensure consistent identification of creditor entities, we employ a mix of automated and manual cleaning.

Automated fuzzy matching: In a first step, we leverage both traditional string similarity methods and large language model-based matching via the Hugging Face Transformers library (Wolf et al., 2020), to identify creditor entities with highly similar spelling (e.g. "Citibank, N.A." and "Citibank, NA"). We then manually review all entries with similarity scores above 0.85 for string similarity method; and all proposed matches for the large-language model-based matching and standardize spelling wherever applicable.

Manual consolidation: In a second step, we move beyond differences in spelling and engage in manual cleaning to ensure that creditor entities are consistently recorded as consolidated institutional units. This means that subsidiaries, branches, or regional offices of a global banking group (e.g. Citibank London Branch, Citibank do Brasil S.A., Citibank New York) are treated as belonging to the same creditor entity ("Citigroup"). This approach reflects the fact that banking groups make lending decisions under a common balance sheet or brand, even though some debtor countries may report the name of a subsidiary or regional office to the Debtor Reporting System.

Creditor type classification: In the Debtor Reporting System, reporting countries classify each creditor into several distinct creditor type categories. In line with the existing academic literature, our focus in the empirical analysis is entirely on *private*, external creditors, i.e. commercial banks and bonds. The Debtor Reporting System defines these two creditor types as follows:

- **Financial institutions:** These creditor category type includes commercial bank or other financial institution that is "all commercial banks, whether or not publicly owned, as well as other financial institutions, such as finance companies, merchant banks, insurance companies, and the like." (World Bank, 2000)
- **Bonds:** "Bond. Include all bond issues, whether publicly offered or privately placed." (World Bank, 2000)

One challenge in this context arises from occasional inconsistencies in how debtor countries classify their creditors. In rare cases, the same institution appears under different creditor-type categories across reporting countries or years—for example, a bank may be recorded as a private commercial lender by some debtors but as a bilateral official creditor by others. To ensure consistent classification across countries and over time, we assign each creditor entity to the modal creditor-type category—that is, the category under which it is most frequently reported. Accordingly, an institution is classified as a private external creditor if more debtor countries identify it as private than as any other type.

Taken together, our cleaning and consolidation approach reduces the number of unique private, external creditor entities from a total of 2,869 entities in the non-standardized data to 1,886 different entities in the consolidated final dataset.

A.1.3 Scope of data, variable definitions and sample

Our final data sample covers 50,778 loans extended by 1,886 different commercial banks and financial institutions as well as 4,103 public and privately-placed bond issues. For each of these transactions, we know the commitment amount, the month of the commitment, the interest rate, and annual outstanding debt stocks until maturity. Here we provide detailed definitions for each of these variables.

Commitment amount: The face value of the loan or bond, as specified in the lending contract, without extracting commitment or underwriting fees and regardless of whether actual disbursements have been made. All commitment amounts in our dataset are converted into nominal US Dollars using exchange rate data from the IMF International Financial Statistics, regardless of the original currency denomination of the instrument.

Commitment date: The commitment date is the month in which the lending agreement between the financial institution and the borrower is signed, or the month in which the bond is issued. Again, this definition is independent of the timing of subsequent disbursements.

Interest rate: Our data includes information on both the interest type and the interest rate margin. For each transaction, we know whether the instrument has zero interest, a fixed interest rate, or a variable interest rate. The interest rate margin then gives us the fixed interest rate (in the case of a fixed rate loan) or the margin over the reference rate in the case of a variable interest rate instrument).

Outstanding debt stocks: As discussed in the main text, a key advantage of our data is that it allows to track annual outstanding debt stocks for each transaction over time. For each year from commitment date to maturity, we know the amount of debt that is disbursed and outstanding, i.e. not yet repaid. As for commitment amounts, this information is provided in US Dollars regardless of the original currency denomination of the debt.

At the country-year level, the coverage of our data is determined by the reporting status of a country to the World Bank. Table A1 lists all included developing and emerging market countries and their first and last reporting year in our data. An additional column lists default dates as defined by (Asonuma and Trebesch, 2016).

Table A1: Data coverage by country and year

Country	Start year	End year	Default episodes
Afghanistan	1970	2020	
Albania	1989	2020	1991
Algeria	1970	2020	1990, 1994
Angola	1976	2020	
Argentina	1970	2020	1983, 1985, 1988, 2002, 2020
Armenia	1991	2020	
Azerbaijan	1992	2020	
Bangladesh	1972	2020	
Belarus	1992	2020	
Belize	1970	2020	2006, 2012, 2016, 2020
Benin	1970	2020	
Bhutan	1974	2020	
Bolivia	1970	2020	1980, 1988
Bosnia and Herzegovina	1970	2020	1992
Botswana	1970	2020	
Brazil	1970	2020	1983, 1984, 1987, 1989
Bulgaria	1971	2020	1990
Burkina Faso	1970	2020	
Burundi	1970	2020	
Cabo Verde	1975	2020	
Cambodia	1970	2020	
Cameroon	1970	2020	1985
Central African Republic	1970	2020	
Chad	1970	2020	2014, 2017
China	1978	2020	
Colombia	1970	2020	
Comoros	1970	2020	
Congo, Dem. Rep.	1970	2020	1975, 1982, 1983, 1984, 1985, 1986, 1987
Congo, Rep.	1970	2020	1983, 1988, 2019
Costa Rica	1970	2020	1981, 1984, 1986
Cote d'Ivoire	1970	2020	1983, 2000, 2011
Djibouti	1970	2020	
Dominica	1970	2020	2003
Dominican Republic	1970	2020	1982, 1987, 2004
Ecuador	1970	2020	1982, 1983, 1984, 1987, 1999, 2008, 2020
Egypt, Arab Rep.	1970	2020	

Country	**Start year**	**End year**	**Default episodes**
El Salvador	1970	2020	
Eritrea	1993	2020	
Eswatini	1970	2020	
Ethiopia	1970	2020	1990
Fiji	1970	2020	
Gabon	1970	2020	1986, 1989
Gambia, The	1970	2020	1984, 2018
Georgia	1992	2020	
Ghana	1970	2020	
Grenada	1970	2020	2004, 2013
Guatemala	1970	2020	
Guinea	1970	2020	1985, 1991
Guinea-Bissau	1974	2020	
Guyana	1970	2020	1982, 1993
Haiti	1970	2020	
Honduras	1970	2020	1981, 1990
India	1970	2020	
Indonesia	1970	2020	
Iran, Islamic Rep.	1970	2020	
Jamaica	1970	2020	1977, 1978, 1980, 1983, 1984, 1986, 1987
Jordan	1970	2020	1989
Kazakhstan	1992	2020	
Kenya	1970	2020	1992
Kosovo	2002	2020	
Kyrgyz Republic	1992	2020	
Lao PDR	1970	2020	
Lebanon	1970	2020	2020
Lesotho	1970	2020	
Liberia	1970	2020	1980
Madagascar	1970	2020	1981, 1982, 1985, 1987
Malawi	1970	2020	1982, 1987
Maldives	1976	2020	
Mali	1970	2020	
Mauritania	1970	2020	1992
Mauritius	1970	2020	
Mexico	1970	2020	1982, 1984, 1986, 1987, 1989
Moldova	1991	2020	2001, 2002
Mongolia	1985	2020	2017
Montenegro	2000	2020	
Morocco	1970	2020	1983, 1985, 1989
Mozambique	1972	2020	1983, 2015, 2016, 2017

Country	Start year	End year	Default episodes
Myanmar	1970	2020	
Nepal	1970	2020	
Nicaragua	1970	2020	1978, 1981, 1982, 1983, 1985
Niger	1970	2020	1983, 1984, 1986
Nigeria	1970	2020	1982, 1983, 1986, 1987, 1988, 1990
North Macedonia	1970	2020	1992
Pakistan	1970	2020	1998, 1999
Papua New Guinea	1970	2020	
Paraguay	1970	2020	1986
Peru	1970	2020	1976, 1979, 1983, 1984
Philippines	1970	2020	1983, 1986, 1988, 1990
Russian Federation	1974	2020	1991, 1998, 1999
Rwanda	1970	2020	
Samoa	1970	2020	
Sao Tome and Principe	1970	2020	1984
Senegal	1970	2020	1981, 1985, 1990, 1992
Serbia	1970	2020	1992
Sierra Leone	1970	2020	1980
Solomon Islands	1970	2020	
Somalia	1970	2020	
South Africa	1980	2020	1985, 1989, 1992
Sri Lanka	1970	2020	
St. Lucia	1971	2020	
St. Vincent and the Grenadines	1970	2020	
Sudan	1970	2020	1975
Syrian Arab Republic	1970	2020	
Tajikistan	1990	2020	
Tanzania	1970	2020	1981
Thailand	1970	2020	
Timor-Leste	2012	2020	
Togo	1970	2020	1987, 1991
Tonga	1970	2020	
Tunisia	1970	2020	
Turkey	1970	2020	1976, 1981
Turkmenistan	1992	2020	
Uganda	1970	2020	1979
Ukraine	1992	2020	1998, 1999, 2000, 2015
Uzbekistan	1992	2020	
Vanuatu	1970	2020	
Vietnam	1970	2020	1982

Country	Start year	End year	Default episodes
Yemen, Rep.	1970	2020	1983
Zambia	1970	2020	1983, 2020
Zimbabwe	1970	2020	

Notes: This table summarizes the coverage of our micro-level dataset across countries and years. The final column shows all default episodes by country, as measured by Asonuma and Trebesch (2016).

A.2 Other data sources

This subsection introduces all other variables and data sources used in our analysis of default costs.

Data on default events: Data on sovereign default episodes are taken from Asonuma and Trebesch (2016). In our analysis of market exclusion and credit-related default costs (Sections 3 and 4), we use the month (or year) in which the default or restructuring process begins. Following the definition in Asonuma and Trebesch (2016), this is either the month in which the government first misses a payment to external, private creditors beyond the contractual grace period or the month when a senior government official publicly announces a debt restructuring—whichever occurs earlier.

Data on sovereign credit ratings: To systematically characterize the revealed risk preferences of creditors in developing country sovereign debt markets in 4.2, we merge data on creditor portfolios with the comprehensive data on sovereign credit risk ratings compiled by Horn et al. (2020). They combine the sovereign credit risk ratings of major rating agencies such as Moody's, Standard & Poor's and Fitch with country risk assessments published by Institutional Investor Research (II Research). To make ratings comparable across sources, all ratings are mapped to a numerical scale from -4 to 20 following the approach of Reinhart et al. (2017). When more than one credit rating is available for a given country and year, an unweighted average of available ratings is calculated.

Macroeconomic control variables: For all macroeconomic control variables, such as nominal GDP, we rely on the World Bank World Development Indicators, unless otherwise noted.

B Market exclusion: Additional results and robustness

This appendix section provides additional material on the main finding of Section 3 that most sovereigns retain partial market access even during years of outright default. Section B.1 situates our results within the existing empirical literature and elaborates on how our approach differs from previous contributions. The following subsections present additional details on our findings: Section B.2) shows exclusion estimates by individual episodes and Section Section B.3 discusses three default episodes in greater depth. Finally, Section B.4 revisits the Kaplan-Meier survival functions under alternative assumptions and for selected subsamples.

B.1 Comparing our results to the existing literature

In this section, we provide a detailed comparison of our empirical findings with those of the existing literature. Table B2 sets the stage by comparing post-default exclusion estimates across several empirical contributions. As discussed in the main text, there is a striking discrepancy between our finding that the median defaulter re-enters the market after only 9 months and median exclusion periods of 3 to 7 years reported in prior studies. To better understand the drivers of this discrepancy, we review in detail the empirical approaches and measurement choices underlying the existing estimates.

Table B2: Market exclusion estimates - comparing our results to the literature

	Exclusion duration	**Sample period**
Gelos et al. (2011)	4	1980-2000
Cruces and Trebesch (2013)	7	1980-2010
Richmond et al. (2024)	3-4	1980-2005
Literature average	5	1975-2014
Our estimate	0.75	1970-2020

Notes: This table summarizes estimates of market exclusion after default. Each estimate shows the median time between default and partial market reaccess according to different empirical studies (see below for detailed definitions). As in Schmitt-Grohe and Uribe (2017), we add the median time between the default event and the restructuring event (2 years according to Asonuma and Trebesch (2016)) to the estimated exclusion time if exclusion during default is assumed by the authors. For Richmond et al. (2024), we show estimated medians for both gross partial market access (3 years) and for net partial market access (4 years). (see Figure 2 and text for details).

Empirical estimates of market exclusion date back to the seminal contribution by Gelos et al. (2011) who use both micro and aggregate data to measure post-default market exclusion over the period 1980 to 2000. To identify default events, they rely on data from Standard & Poor's which records the years in which a sovereign defaulted on foreign currency bond or bank debt (Beers and Chambers, 2004). Market access is defined through two necessary conditions: a sovereign is considered to have market access when it records a "public or publicly guaranteed international bond issuance or borrowing through a private syndicated bank loan" and simultaneously experiences an increase in the country's aggregate public indebtedness (p. 244). To determine whether a country's aggregate indebtedness increases, the authors use data from the World Bank's Global Development Finance database (the predecessor of the World Bank's International Debt Statistics dataset used in our analysis).

Subsequent work by Cruces and Trebesch (2013), Richmond and Dias (2009) and Richmond et al. (2024) has adopted and expanded this market access definition. Cruces and Trebesch (2013) consider a sovereign to have market access if it is able to contract a bond or a syndicated loan *and* if its aggregate debt stock with private, external creditors increases in the same year. Consistent with Gelos et al. (2011), they use data from Dealogic to identify individual bank and bond loans and data from the World Bank's International Debt Statistics to identify net increases in public indebtedness. Richmond and Dias (2009) and Richmond et al. (2024) instead rely exclusively on aggregate data from the World Bank's International Debt Statistics to identify market access. They explore a range of different market access criteria - distinguishing between flows to private and public recipients, net versus gross flows, and full versus partial access. They show that the market access definition has first-order impact on exclusion estimates. Their definition of gross, partial access is conceptually closest to our micro-data approach and yields fast re-access into the international capital market.[22]

A key difference between our approach and Richmond et al. (2024), however, is that they-in line with Cruces and Trebesch (2013)-assume that sovereigns cannot access capital markets during default years and restrict their analysis to market exclusion times after a restructuring with private creditors has been concluded.[23] In contrast, our micro-level evidence shows that countries routinely borrow from international creditors during default years. Consequently, while Richmond et al. (2024) find rapid reaccess after *restructurings*, the implied exclusion duration after *default* remain substantially longer than those observed in our data.

[22]Richmond et al. (2024) define a country to have partial, gross access if its aggregate gross flows from private, external creditors are larger than zero. With this approach, they find very short post-restructuring exclusion periods of year for the median sovereign. Note that this approach is less restrictive than our micro-level definition of market access because it cannot account for purely defensive lending.

[23]As cited in the main text, Richmond et al. (2024) argue that "technically, a country does not have access to capital markets while in default". Similarly, Cruces and Trebesch (2013) state that "it is now a well-established stylized fact that countries are not able to borrow during default."

B.2 Exclusion estimates by episode

Table B3: Default, restructuring and market access, 1970 - 2020

Country	Default	Restructuring	Re-access	Exclusion (in months)
Albania	1991	1995	2007	187
Algeria	1990	1992	1990	2
Algeria	1993	1996	1994	1
Argentina	1982	-	1982	4
Argentina	1985	1985	1985	1
Argentina	1988	1993	1988	5
Argentina	2001	2005	2002	3
Argentina	2019	2020	2020	2
Belize	2006	2007	2007	6
Belize	2012	2013	2013	7
Belize	2016	2017	2017	3
Belize	2020	2020	-	-
Bolivia	1980	1988	1981	4
Bolivia	1988	1993	1988	7
Bosnia & Herzegovina	1992	1997	1997	66
Brazil	1982	-	-	-
Brazil	1983	1983	1983	1
Brazil	1984	-	1984	1
Brazil	1986	1986	1986	2
Brazil	1989	1992	1989	1
Bulgaria	1990	1994	1990	3
Cameroon	1985	2003	1986	18
Chad	2014	2015	-	-
Chad	2017	2018	-	-
Congo, Dem. Rep.	1975	1980	1976	12
Congo, Dem. Rep.	1982	1983	-	-
Congo, Dem. Rep.	1983	1984	-	-
Congo, Dem. Rep.	1984	1985	1984	2
Congo, Dem. Rep.	1985	1986	-	-
Congo, Dem. Rep.	1986	1987	-	-
Congo, Dem. Rep.	1987	1989	1987	4
Congo, Rep.	1983	1988	1983	4
Congo, Rep.	1988	2007	1988	2
Congo, Rep.	2018	-	-	-
Costa Rica	1981	1983	1981	1
Costa Rica	1984	1985	1985	3
Costa Rica	1986	1990	1989	43

Country	**Default**	**Restructuring**	**Re-access**	**Exclusion** (in months)
Cote d'Ivoire	1983	1998	1983	2
Cote d'Ivoire	2000	2010	2009	112
Cote d'Ivoire	2011	2012	2012	22
Dominica	2003	2004	2004	11
Dominican Republic	1982	1986	1983	16
Dominican Republic	1987	1994	1988	12
Dominican Republic	2004	-	-	-
Dominican Republic	2004	2005	2005	10
Ecuador	1982	1983	1983	9
Ecuador	1983	-	1984	1
Ecuador	1984	1984	1985	9
Ecuador	1986	1995	1986	2
Ecuador	1999	2000	2000	19
Ecuador	2008	2009	2013	56
Ecuador	2020	2020	-	-
Ethiopia	1990	1996	1991	12
Gabon	1986	1987	1987	9
Gabon	1989	1994	1991	30
Gambia, The	1984	1988	1988	43
Gambia, The	2018	-	-	-
Grenada	2004	2005	2005	11
Grenada	2013	2015	2016	34
Guinea	1985	1988	1988	34
Guinea	1991	1998	2004	159
Guyana	1982	1992	1984	29
Guyana	1993	1999	1996	39
Honduras	1981	1989	1981	3
Honduras	1990	2001	1990	4
Jamaica	1977	-	1977	1
Jamaica	1978	1978	1978	4
Jamaica	1980	1981	1981	13
Jamaica	1983	1984	1983	4
Jamaica	1984	1985	1984	5
Jamaica	1986	1987	1987	4
Jamaica	1987	1990	1988	8
Jordan	1989	1993	1990	22
Kenya	1992	1998	1995	36
Lebanon	2020	-	-	-
Liberia	1980	1982	1982	25
Madagascar	1981	1981	1981	4

Country	**Default**	**Restructuring**	**Re-access**	**Exclusion** (in months)
Madagascar	1982	1984	1983	12
Madagascar	1985	-	1986	14
Madagascar	1987	1987	2008	256
Malawi	1982	1983	1983	11
Malawi	1987	1988	1988	11
Mauritania	1992	1996	2001	109
Mexico	1982	1983	1982	2
Mexico	1984	1985	1984	1
Mexico	1986	1987	1986	1
Mexico	1987	1988	1987	4
Mexico	1988	1990	1989	1
Moldova	2001	-	2002	10
Moldova	2002	2002	2003	15
Mongolia	2017	2017	2017	1
Morocco	1983	-	1983	1
Morocco	1985	1986	1986	3
Morocco	1989	1990	1989	2
Mozambique	1983	1991	1984	8
Mozambique	2015	2016	-	-
Mozambique	2016	2019	2019	38
Nicaragua	1978	1980	1979	9
Nicaragua	1981	1981	1981	5
Nicaragua	1982	-	1983	7
Nicaragua	1983	1984	1984	10
Nicaragua	1985	1995	1985	8
Niger	1983	1984	1983	5
Niger	1984	1986	1985	17
Niger	1986	1991	1989	33
Nigeria	1982	1983	1982	1
Nigeria	1983	1984	1984	8
Nigeria	1986	-	1987	14
Nigeria	1987	1987	1987	1
Nigeria	1988	-	1989	12
Nigeria	1989	1989	1989	6
North Macedonia	1992	1997	1995	38
Pakistan	1998	-	-	-
Pakistan	1999	1999	2001	27
Paraguay	1986	1993	1986	5
Peru	1976	1978	1976	2
Peru	1979	1980	1979	1

Country	Default	Restructuring	Re-access	Exclusion (in months)
Peru	1983	1983	1983	2
Peru	1984	1997	1984	1
Philippines	1983	1986	1983	2
Philippines	1986	1987	1987	4
Philippines	1988	1990	1989	10
Philippines	1990	1992	1990	3
Russian Federation	1991	1997	1991	2
Russian Federation	1998	-	-	-
Russian Federation	1998	-	-	-
Russian Federation	1999	1999	2000	15
Sao Tome & Principe	1984	1994	1984	3
Senegal	1981	1984	1981	7
Senegal	1985	-	1986	12
Senegal	1990	1990	-	-
Senegal	1992	1996	1997	65
Serbia	1992	2004	2002	117
Sierra Leone	1980	1995	1981	7
South Africa	1985	1987	-	-
South Africa	1989	1989	1991	28
South Africa	1992	1993	1992	1
Sudan	1975	1985	1975	3
Tanzania	1981	2004	1981	1
Togo	1987	1988	1988	11
Togo	1991	1997	2015	285
Turkey	1976	1979	1977	1
Turkey	1981	1981	1981	7
Uganda	1979	1993	1979	3
Ukraine	1998	1998	1998	1
Ukraine	1999	1999	-	-
Ukraine	2000	2000	2000	3
Ukraine	2015	2015	2016	20
Vietnam	1982	1997	1994	149
Yemen, Rep.	1983	2001	1985	19
Zambia	1983	1994	1984	17
Zambia	2020	-	-	-

Notes: This table summarizes our estimates of market exclusion by episode. Each row shows the defaulting country, the year of default and the year of the restructuring as measured by Asonuma and Trebesch (2016), as well as the year of first re-access as identified in our loan-level data (see Section 3 for details). The final column shows the number of months between default and re-access, in which no external borrowing from private, external creditors occurred. No exclusion duration is provided if the defaulter has not re-accessed capital markets as of 2020, or if it entered another default episode before re-accessing the market.

B.3 Case studies

This appendix section provides additional case studies to illustrate how measurement of market access and exclusion can differ in aggregate and micro data.

Bolivia 1980

Figure B1 shows Bolivia's external borrowing from international private creditors over two decades from 1978 to 1998. After default on international commercial bank lenders in 1980, it took the country until 1993 to reach a comprehensive restructuring and to resolve the default episode (Morales and Sachs, 1989; Asonuma and Trebesch, 2016). Existing studies consider Bolivia's 1980 default to be followed by one of the longest episodes of market exclusion. According to Gelos et al. (2011), for example, the country never managed to re-access the international capital market prior to 2000, when their sample ends. In Cruces and Trebesch (2013), and in line with Panel A of Figure B1, the country re-enters the market in 1997 when net flows with private creditors turn positive for the first time after default resolution.

The analysis of our loan-level data yields a different picture (Panel B). While it is true Bolivia issued only few loans in the international capital market during the 1980s and 1990s, there are repeated instances of market access. In the early 1980s, almost immediately after the initial default, the country managed to launch several large syndicated loans with international banks, including for example a 400 million USD, 3-year maturity loan in 1981 with participation from Citi, Bank of America, Dresdner Kleinwort, and Wells Fargo, among others (see e.g. World Bank 1984 or IMF 1983). Importantly, and as seen in our micro-level data, these transaction led several banks to increase their total exposure to Bolivia, in line with our market access definition introduced in Section 3.1.2.

Mexico 1982

Figure B2 revisits external borrowing by Mexico during its 1980s debt crisis in both aggregate (Panel A) and micro data (Panel B). In 1982, Mexico entered a prolonged debt distress period, in which it repeatedly defaulted and restructured with its external private creditors (Buffie and Krause, 1989). In most existing studies of market exclusion, Mexico is *assumed* to be excluded from the international capital market during this period and until the conclusion of its final restructuring agreement with private external creditors in 1990 (see Figure 2 for an illustration of the different timing conventions).

Both aggregate and micro data, however, show that this assumption is not an accurate depiction of Mexico's international capital market access during the 1980s. According to World Bank policy reports from the 1980s, Mexico managed to contract at least 66 syndicated bank loans between 1982 and 1990 (see World Bank - Borrowing in the International Capital Market (multiple years), or IMF (1983)) and experienced net capital inflows during several years (Panel A). Our loan-level data shows that many of Mexico's existing creditor banks increased their exposure through these issues, and new banks entered the market. A subset of these creditors is shown in Panel B, but it is worth keeping in mind that Mexico had borrowed from more than 1,000 international commercial banks at the time of default (IMF, 1983). While many of these creditor banks would never lend to Mexico again (in line with our evidence in Section 4), Mexico retained some borrowing opportunities even during years of default.

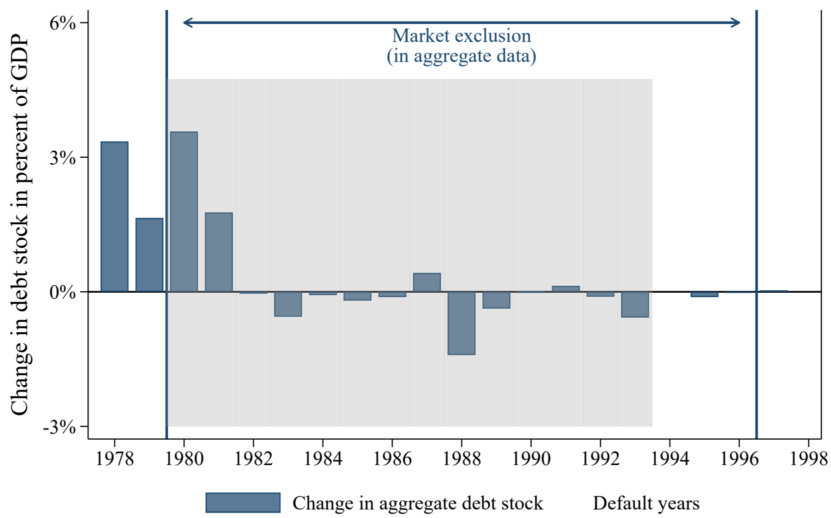
Pakistan 1998

In 1998, Pakistan defaulted on its external, private creditors and completed a comprehensive debt restructuring within less than a year Asonuma and Trebesch (2016); Sturzenegger and Zettelmeyer (2006). Yet, net financial flows with international private creditors remained negative for multiple years, leading existing studies to conclude that market re-access only occurred in 2004 after 6 years of market exclusion (Panel A of Figure B3).

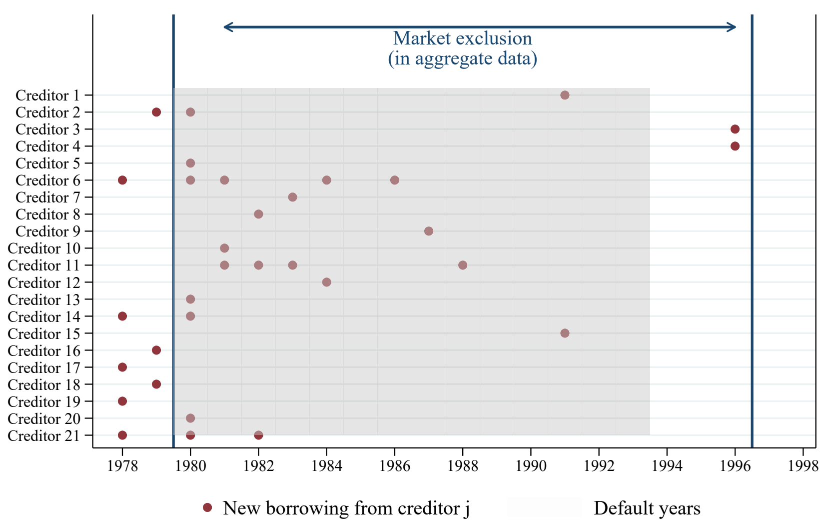
During this time, however, our micro-level data shows repeated new borrowing by Pakistan from international private banks (see Panel B of Figure B3 for borrowing with a subset of individual creditor entities). Several of these transactions can also be confirmed in publicly available data. World Bank reports on the international syndicated loan market show for example that Pakistan managed to borrow 200 million Euro from American and Saudi Arabian commercial banks in 2000 and 2001.

Figure B1: Market access in aggregate vs. micro data: Bolivia 1980

Panel A: Market exclusion in aggregate data



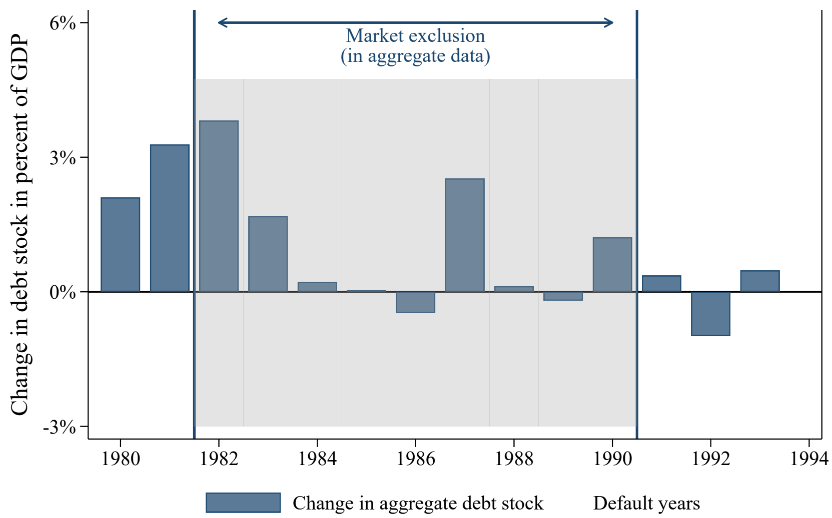
Panel B: Market access in micro data



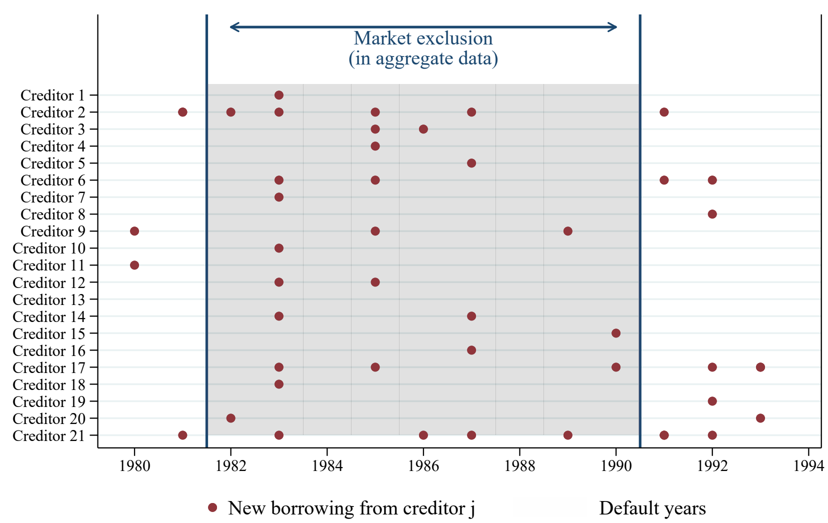
Notes: This figure shows market access by Bolivia prior, during and after its 1980 sovereign default as seen through both aggregate and micro data. Panel A shows aggregate net transfers in percent of GDP and thereby illustrates how the existing literature has measured market exclusion after default. Panel B depicts the same episode through the lens of our novel micro data. Each new transaction follows the baseline definition provided in Section 3.1.2 with $\delta = 1$. The grey shaded bars show years between the default event and the debt restructuring and are taken from Asonuma and Trebesch (2016). For confidentiality reasons, the names of the different creditor institutions have been erased.

Figure B2: Market access in aggregate vs. micro data: Mexico 1982

Panel A: Market exclusion in aggregate data



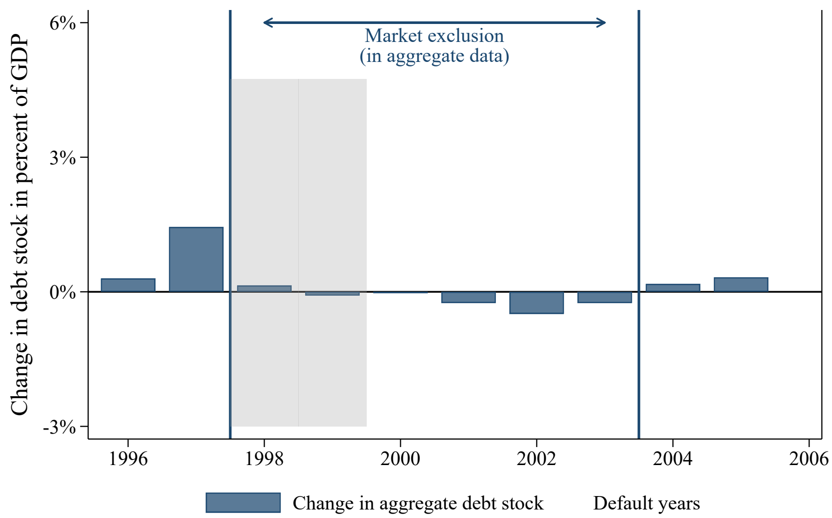
Panel B: Market access in micro data



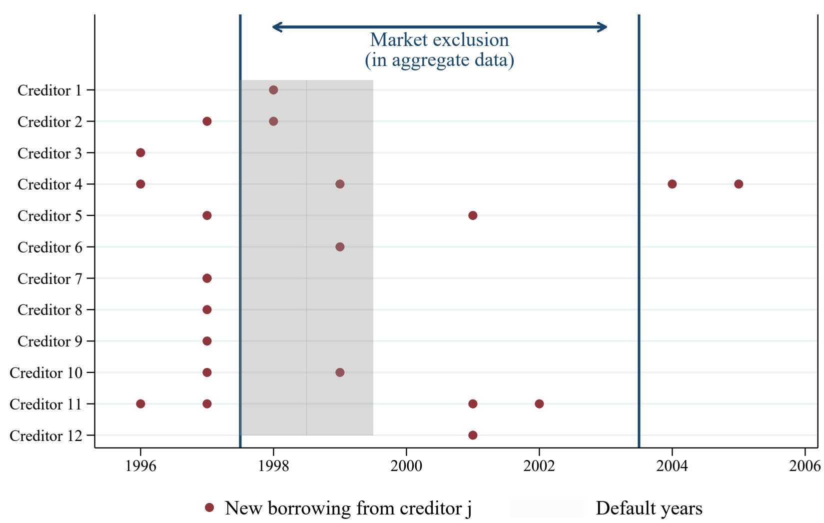
Notes: This figure shows market access by Mexico prior, during and after its 1982 sovereign default as seen through both aggregate and micro data. Panel A shows aggregate net transfers in percent of GDP and thereby illustrates how the existing literature has measured market exclusion after default. Panel B depicts the same episode through the lens of our novel micro data. Each new transaction follows the baseline definition provided in Section 3.1.2 with $\delta = 1$. The grey shaded bars show years between the default event and the debt restructuring and are taken from Asonuma and Trebesch (2016). For confidentiality reasons, the names of the different creditor institutions have been erased.

Figure B3: Market access in aggregate vs. micro data: Pakistan 1998

Panel A: Market exclusion in aggregate data



Panel B: Market access in micro data



Notes: This figure shows market access by Pakistan prior, during and after its 1998 sovereign default as seen through both aggregate and micro data. Panel A shows aggregate net transfers in percent of GDP and thereby illustrates how the existing literature has measured market exclusion after default. Panel B depicts the same episode through the lens of our novel micro data. Each new transaction follows the baseline definition provided in Section 3.1.2 with $\delta = 1$. The grey shaded bars show years between the default event and the debt restructuring and are taken from Asonuma and Trebesch (2016). For confidentiality reasons, the names of the different creditor institutions have been erased.

B.4 Kaplan-Meier survival functions - robustness

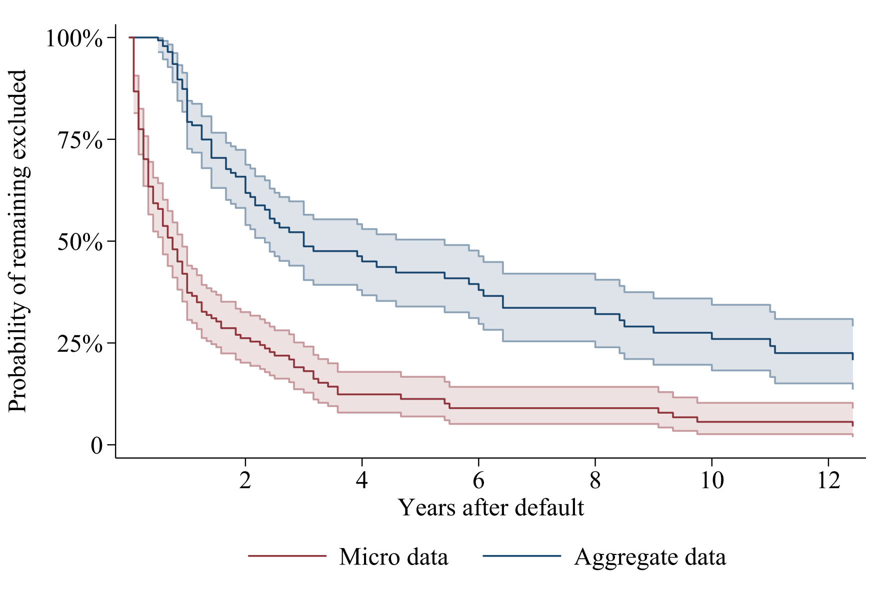
This section presents additional Kaplan-Meier survival functions to show that our core result of 'no full market exclusion' post-default is robust to different market access definitions and to using different sub-samples of the data.

B.4.1 Accounting for defensive lending

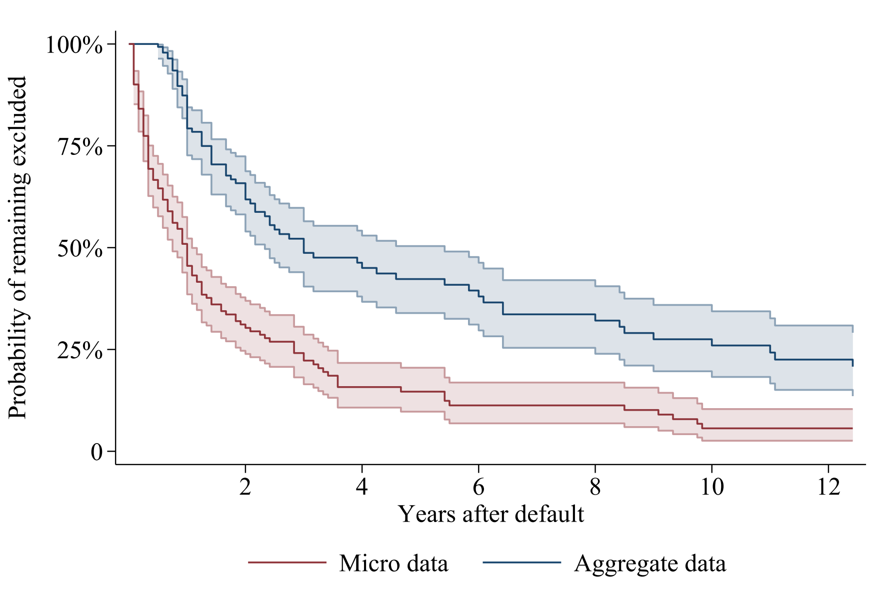
As described in Section 3, a key concern is that observed instances of market access during default could be solely driven by defensive lending motives. In that case, new transactions would not constitute 'fresh' financing but rather represent exposure management by existing creditors. We address this concern in two ways: First, we alter the threshold δ above which an increase in a creditor j's debt stock is considered new lending. Figure B4 shows that are our estimated exclusion times hardly change and remain strongly distinct from exclusion times inferred from aggregate data. In a second exercise, we focus on market re-access with new creditors only. For this exercise, we distinguish between borrowing at the extensive and intensive margin. Access at the intensive margin occurs when the sovereign borrows additional funds from existing creditors, whereas access at the extensive margin occurs when it borrows from an external private creditor with no outstanding claims on the sovereign in the current year. Accessing the market at the extensive margin can be considered a particularly strong signal, as — by definition — such lending cannot serve defensive purposes. Figure B5 shows that 50 percent of sovereigns contract lending from new creditors within the first year of default.

Figure B4: Kaplan-Meier Survival Functions for market exclusion - different access definitions

Panel A: Setting $\delta = 1.08$

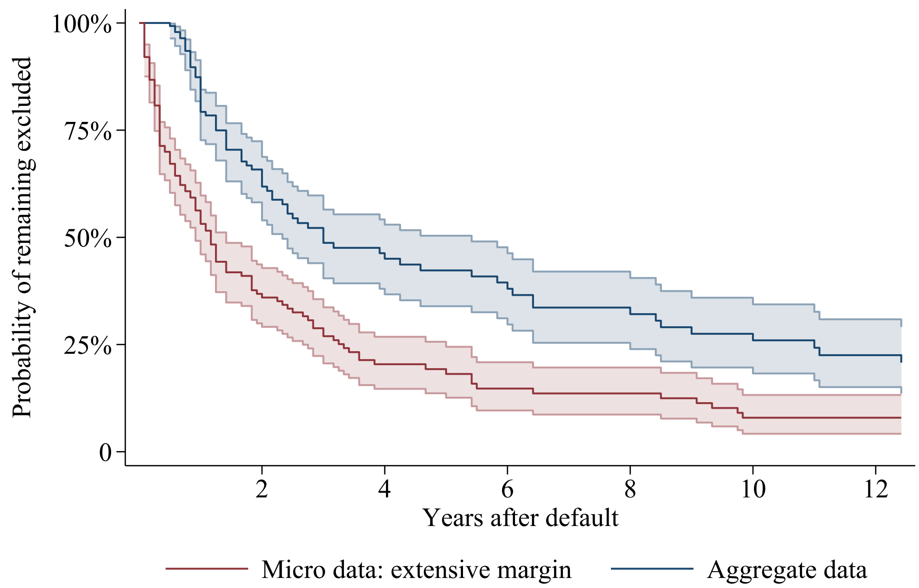


Panel B: Setting $\delta = 2$



Notes: This figure plots Kaplan-Meier survival functions for market exclusion after sovereign defaults for different market access definitions. As in the main text, the red lines shows the probability of remaining excluded from the market as measured in our novel micro level-level data (see Section 2). Panel A uses a δ parameter of 1.08 which corresponds to the average coupon rate in our data, Panel B uses a δ parameter equal to 2. The blue lines shows the probability of remaining excluded as measured in aggregate data (see Section 3.1.2). Shaded areas indicate 90% confidence intervals. Data on sovereign default events is from Asonuma and Trebesch (2016).

Figure B5: Kaplan-Meier Survival Functions for market exclusion - new creditors only

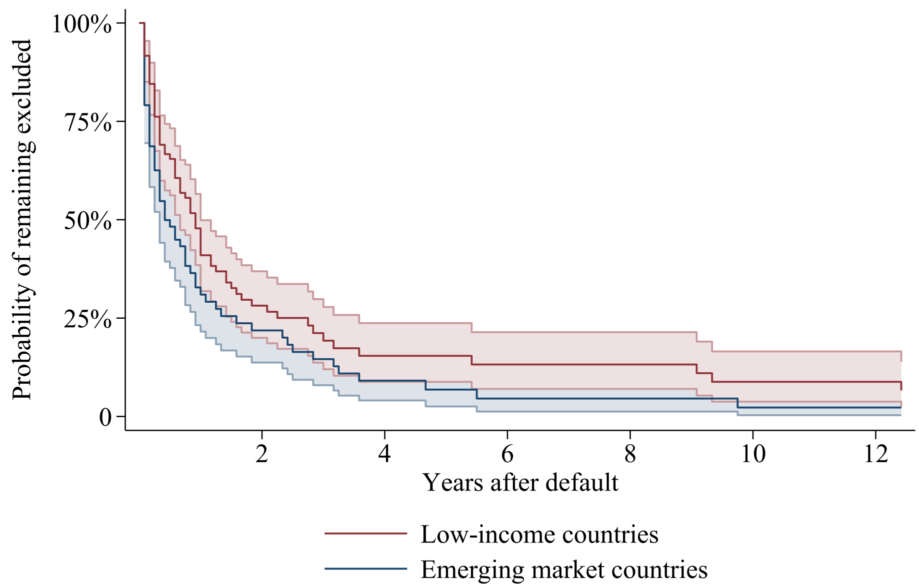


Notes: This figure plots Kaplan-Meier Survival functions for market exclusion after sovereign defaults. The red line shows the probability of remaining excluded from the market as measured in our novel micro level-level data (see Section 2) In contrast to the estimate shown in the main text, this exercise only considers market access at the extensive margin that is borrowing from new creditors. The blue line shows the probability of remaining excluded as measured in aggregate data (see Section 3.1.2). Shaded areas indicate 90% confidence intervals. F(1) refers to the compound probability of re-accessing the market within the first year post-default. Data on sovereign default events is from Asonuma and Trebesch (2016).

B.4.2 Market exclusion by income group

In this subsection, we estimate separate Kaplan Meier survival functions for different income groups. More specifically, we distinguish between low-income and lower-middle income countries on the one hand and upper-middle income and high income countries on the other hand. Our classification follows the World Bank World Development Indicator database. Figure B6 shows the corresponding Kaplan Meier survival estimates by income group. The curves show that the large majority of defaulters from both groups experiences almost immediate re-access with some creditors, our core pattern holds in both samples. That said, the distribution of market re-access in low-income countries has a substantially higher median (11 months versus 5 months) and exhibits several outlier values with long exclusion times (see Table **??** for details).

Figure B6: Kaplan-Meier Survival Functions for market exclusion - EMs versus LICs

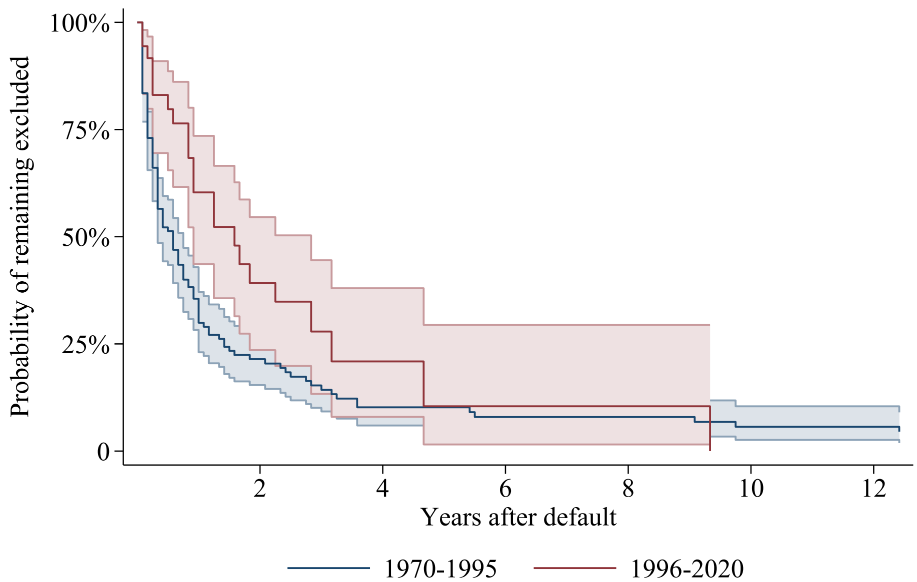


Notes: This figure plots Kaplan-Meier Survival functions for market exclusion after sovereign defaults estimated in our novel micro data. The red line shows the probability of remaining excluded from the market for low and lower-middle income countrie). The blue line shows the probability of remaining excluded upper-middle and high-income countries. Data on sovereign default events is from Asonuma and Trebesch (2016). The country income classification follows the World Bank World Development Indicators.

B.4.3 Market exclusion over time

In this subsection, we examine whether exclusion times are systematically different for early parts of our sample, and in particular for the 1980s debt crisis. For this purpose, Figure B7 estimates separate Kaplan Meier survival functions for default episodes that occurred before 1990, and for default episodes thereafter. The figure confirms that most defaulters regain access to some external private credit almost immediately. However, it also reveals significant differences between the 1980s debt crisis and subsequent crisis episodes.

Figure B7: Kaplan-Meier Survival Functions for market exclusion - 1980s versus modern debt crises



Notes: This figure plots Kaplan-Meier Survival functions for market exclusion after sovereign defaults. The red line shows the probability of remaining excluded from the market as measured in our novel micro level-level data (see Section 2). The blue line shows the probability of remaining excluded as measured in aggregate data (see Section 3.1.2). Shaded areas indicate 90% confidence intervals. F(1) refers to the compound probability of re-accessing the market within the first year post-default. Data on sovereign default events is from Asonuma and Trebesch (2016).

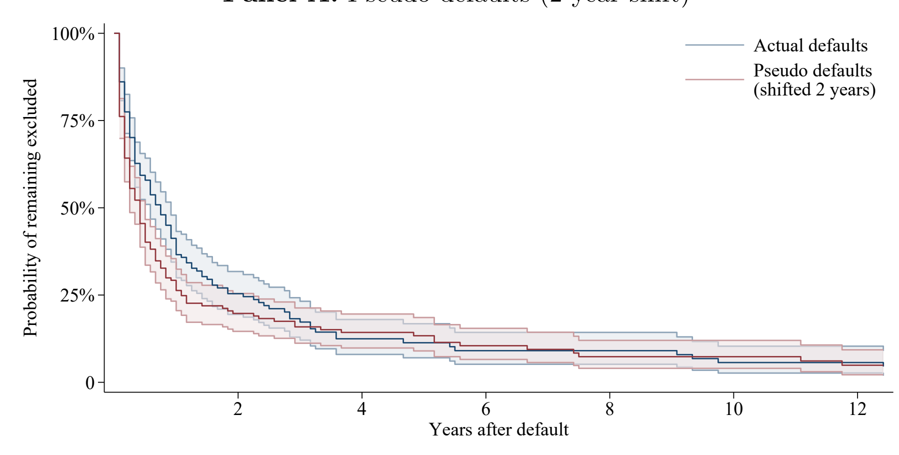
B.4.4 Market access with pseudo treatments

Our analysis of market access in Section 3.1.3 has documented the amount of time post-default until new borrowing takes place. This approach, however, does not distinguish cases in which sovereigns could not borrow and cases in which they chose not to. In other words, the observed time to re-entry may partly reflect demand effects. As a result, the exclusion periods that we observe post-default may *overstate* the effect of default on market access and exclusion may be even shorter than we documented above (also see Schmitt-Grohe and Uribe, 2017).

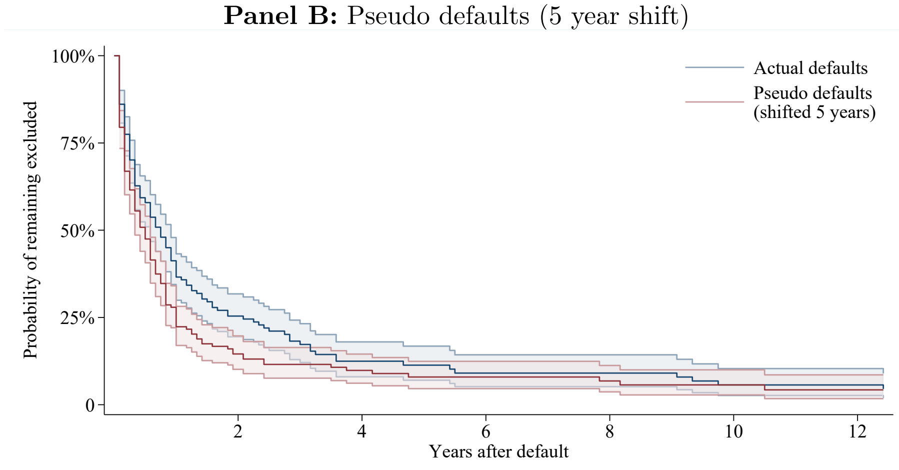
In this appendix subsection, we provide an alternative appraoch at studying market exclusion that takes demand effects into account by benchmarking post-default market access with market access during normal times. For this purpose, Figure B8 compares a Kaplan-Meier survival function for market exclusion after sovereign default to three benchmark survival functions that estimate the exclusion time after pseudo-treatments that occur 2, 4, and 10 years before the actual default event. Figure B8 shows that the resulting survival functions differ only marginally, suggesting that the effect of default on total market exclusion is indeed small, in line with our findings in the maint ext.

Figure B8: Kaplan-Meier Survival Functions for market exclusion - pseudo defaults

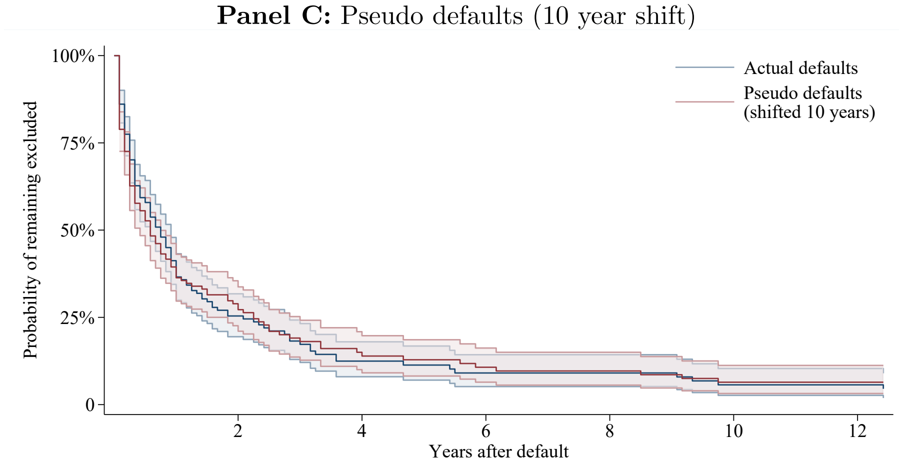
Panel A: Pseudo defaults (2 year shift)



Panel B: Pseudo defaults (5 year shift)



Panel C: Pseudo defaults (10 year shift)



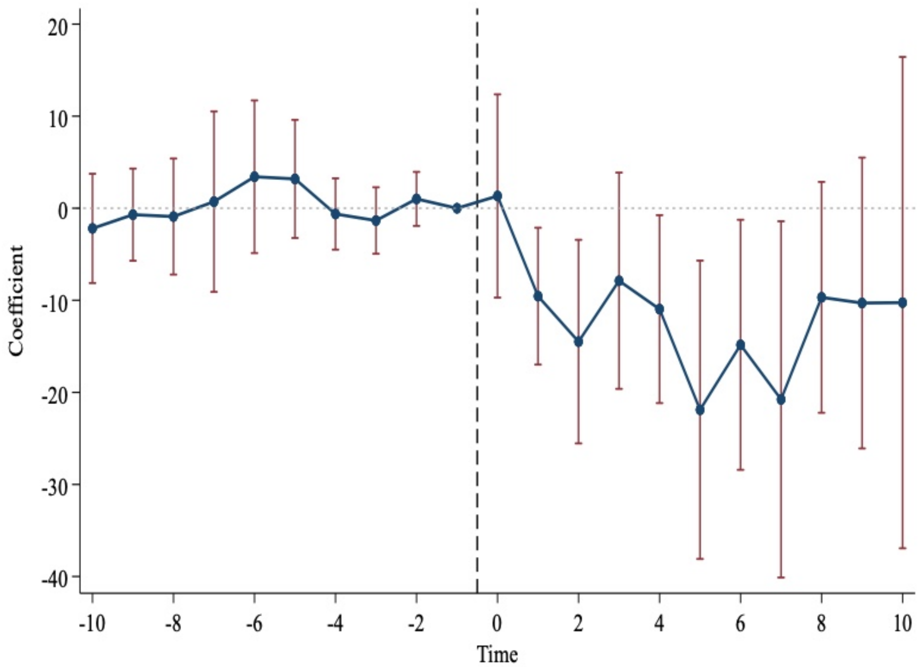
Notes: This figure plots Kaplan-Meier survival functions for market exclusion post sovereign defaults. The red line shows the probability of remaining excluded from the market as measured in our novel micro level data (see Section 2). The lines in shades of blue show the probability of remaining excluded for pseudo defaults, shifted to t-2, t-4 and t-10 respectively. The graph shows the period from (pseudo-) default to ten years after. Data on sovereign default events is from Asonuma and Trebesch (2016).

C Additional empirical results and robustness

This section presents additional empirical results and robustness checks.

C.1 Creditor base erosion - alternative measures

Figure C9: Local Projections Difference-in-Differences: Creditor Count and Default



Notes: This figure shows point estimates and 95% confidence intervals from local projections diff-in-diff regressions with year- and debtor country fixed effects in an unbalanced panel of 4395 sovereign-year observations across 52 absorbing default episodes in 116 debtor countries, 1970–2020. The dependent variable is the number of creditors that provide new credit in each year. Vertical bars indicate 95% confidence intervals clustered at the debtor level. The year prior to default ($h = -1$) is omitted to allow for the interpretation of relative changes. Dashed lines show 95% confidence intervals.

D Model Appendix

D.1 Arellano Economy without Exclusion

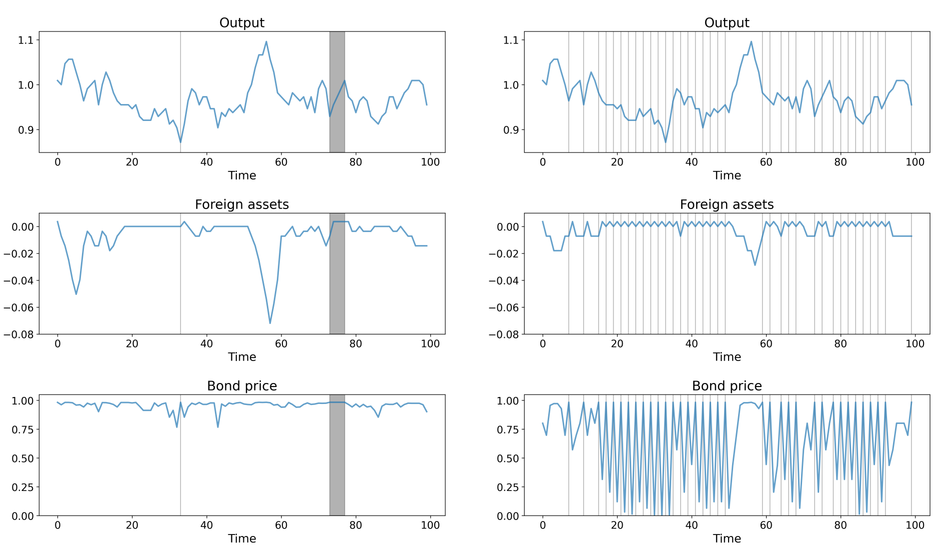
In this appendix, we re-calibrate a workhorse quantitative sovereign debt and default model with our new estimates of market exclusion. Table D4 lists the standard parameters from the seminal work of Arellano (2008) and Figure D10 shows simulated dynamics of output, debt and bond prices. In the model, parameter θ gives the probability that a sovereign re-enters the market from exclusion. In Panel A, we use the original value of 0.282 from Arellano (2008), which is chosen to match exclusion times estimated by Gelos et al. (2011). Panel B shows calibration for $\theta = 0.99$ which yields exclusion times in line with our own estimates presented in Section 3). As becomes clear from the two simulation outcomes below, with our estimates of market exclusion sovereigns can borrow very little. Indeed, they can sustain positive debt levels only in good times, when output is above trend. This is because in the model, additional direct defaults costs to output are assumed to be a product of the market exclusion.

Table D4: Calibration of the Arellano (2008) Model

Parameter	Value
Risk-free interest rate, r	1.7%
Risk aversion, σ	2
Persistence of output, ρ	0.945
Volatility of output, η	0.025
Discount factor, β	0.953
Output cost threshold, $\bar{y}$	0.969

Figure D10: Arellano Economies with and without exclusion

Panel A: Probability of reentry, θ: 0.282 *Panel B:* Probability of reentry, θ: 0.99



Notes: All remaining parameters remain unchanged between the two simulations.

D.2 Proof of Proposition 1: Impossibility of Total Exclusion

Proposition 1 posits that in any equilibrium, total exclusion ($D_t = 0$) cannot occur on-path for $\pi_t > 0$. Equilibria thus require $\min_i M_i < \epsilon_O + (1-\epsilon_O)m(\pi_t = \epsilon_O)$.

Proof 1 *Consider the post-default case where beliefs reset to $\pi_t = \epsilon_O > 0$. Suppose, for contradiction, there exists an equilibrium with on-path market exclusion such that $D_t(\pi_t = \epsilon_O) = 0$.*

Equilibrium consistency requires creditors to correctly anticipate the opportunistic type's repayment strategy $m_t(\pi_t)$. With $D_t = 0$, the opportunistic type faces stage-game indifference: both defaulting and not defaulting yield identical stage-game payoffs of zero. The opportunistic type's strategy is therefore determined entirely by continuation values.

Consider the posterior beliefs under each action. Not defaulting leads to posterior belief:

$$\pi_{t+1}^{ND} = \epsilon_O + (1-\epsilon_C-\epsilon_O)\frac{\pi_t}{M_t} > \epsilon_O,$$

while defaulting resets beliefs to $\pi_{t+1}^{D} = \epsilon_O$.

Since the value function $W(\pi)$ is strictly increasing in π (higher beliefs yield higher reputation, superior borrowing conditions, and hence strictly higher flow payoffs along any continuation trajectory), we have:

$$W(\pi_{t+1}^{ND}) > W(\epsilon_O).$$

The opportunistic type therefore strictly prefers not to default, implying $m_t(\pi_t) = 1$. Given this strategy, reputation evolves according to:

$$M_t(\pi_t) = \pi_t + (1-\pi_t)\cdot m_t(\pi_t) = \pi_t + (1-\pi_t)\cdot 1 = 1.$$

However, $M_t = 1$ implies that for all creditors i, we have:

$$\omega_i(1) = 1 - M_i > 0,$$

where the inequality holds because $M_i < 1$ by assumption. Therefore, $\Omega(1) = \int_i \omega_i(1)\,di > 0$.

From Lemma 1, the committed type's optimal borrowing strategy is:

$$D_t^* = \frac{\Omega(1)}{2b}(Q - \bar{R}) > 0,$$

where the inequality follows from $Q > \bar{R}$ (see section 5.1.2) and $\Omega(1) > 0$.

The opportunistic type mimics this borrowing strategy to avoid revealing its type, so both types issue $D_t = D_t^* > 0$ in equilibrium. This directly contradicts the initial assumption of on-path $D_t = 0$.

Therefore, on-path exclusion is impossible. For equilibria at low beliefs (e.g., post-default $\pi_t = \epsilon_O > 0$) to exist without reputation immediately jumping to $M_t = 1$, we require:

$$\min_i M_i < \epsilon_O + (1 - \epsilon_O)m(\pi_t = \epsilon_O) = M_t(\pi_t = \epsilon_O).$$

This ensures that reputation M_t remains bounded below 1, preventing the contradiction above.

D.3 Mathematical Derivations for Threshold-Based Model

D.3.1 Derivation of Aggregate Preference Parameter

With the heterogeneous threshold-based definition and continuous distribution of M_i, we can define a simpler aggregate preference parameter:

$$\Omega(M_t) = \int_0^{M_t} (M_t - M_i) f(M_i) dM_i \tag{23}$$

Lemma 2 *For a uniform distribution of M_i on $[0, 1]$,*

$$\Omega(M_t) = \frac{M_t^2}{2} \tag{24}$$

This aggregate preference parameter $\Omega(M_t)$ accounts for both the selective participation of creditors and their heterogeneous preferences.

Below we show why:

With the threshold-based definition of $\omega_i(M)$ and continuous distribution of M_i, and assuming $\alpha = 1$, the aggregate preference parameter is:

$$\Omega(M_t) = \int_{i \in I(M_t)} (M_t - M_i) di$$

Where $I(M_t) = \{i : M_i \leq M_t\}$ is the set of active creditors at reputation level M_t.

With a continuous distribution of M_i with density function $f(M_i)$, this becomes:

$$\Omega(M_t) = \int_0^{M_t} (M_t - M_i) f(M_i) dM_i$$

We can rewrite this as:

$$\Omega(M_t) = M_t \int_0^{M_t} f(M_i)dM_i - \int_0^{M_t} M_i f(M_i)dM_i$$

$$\Omega(M_t) = M_t \cdot F(M_t) - \int_0^{M_t} M_i f(M_i)dM_i$$

For a uniform distribution on $[0, 1]$, we have $f(M_i) = 1$ and $F(M_t) = M_t$ for $M_t \in [0, 1]$, so:

$$\Omega(M_t) = M_t \cdot M_t - \int_0^{M_t} M_i dM_i = M_t^2 - \frac{M_t^2}{2} = \frac{M_t^2}{2}$$

D.3.2 Derivation of Optimal Debt Issuance

The committed government solves:

$$\max_{D_t} (Q - R_t)D_t$$

$$s.t. \qquad R_t = \frac{\bar{R} + \frac{bD_t}{\Omega(M_t)}}{1 - (1 - M_t)\bar{\tau}}$$

Taking the derivative with respect to D_t applying the product rule and setting it equal to zero:

$$\frac{\partial}{\partial D_t}[(Q - R_t)D_t] = \frac{\partial(Q - R_t)}{\partial D_t} \cdot D_t + (Q - R_t) \cdot \frac{\partial D_t}{\partial D_t} = -\frac{\partial R_t}{\partial D_t} \cdot D_t + (Q - R_t) \cdot 1$$

$$0 = (Q - R_t) - D_t \cdot \frac{\partial R_t}{\partial D_t} = 0$$

The derivative of R_t with respect to D_t is:

$$\frac{\partial R_t}{\partial D_t} = \frac{b}{\Omega(M_t)(1 - (1 - M_t)\bar{\tau})}$$

Substituting R_t:

$$Q - \frac{\bar{R} + \frac{bD_t}{\Omega(M_t)}}{1 - (1 - M_t)\bar{\tau}} - D_t \cdot \frac{b}{\Omega(M_t)(1 - (1 - M_t)\bar{\tau})} = 0$$

Simplifying:

$$Q - \frac{\bar{R}}{1-(1-M_t)\bar{\tau}} - \frac{bD_t}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} - \frac{bD_t}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} = 0$$

$$Q - \frac{\bar{R}}{1-(1-M_t)\bar{\tau}} - \frac{2bD_t}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} = 0$$

Solving for D_t:

$$\frac{2bD_t}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} = Q - \frac{\bar{R}}{1-(1-M_t)\bar{\tau}}$$

$$D_t^* = \frac{\Omega(M_t)(1-(1-M_t)\bar{\tau})}{2b}\left[Q - \frac{\bar{R}}{1-(1-M_t)\bar{\tau}}\right]$$

D.3.3 Derivation of Reputation Dynamics

The starting point for understanding reputation dynamics is the definition of reputation:

$$M_t =_t +(1-\pi_t)m_t$$

Where, to recall, M_t is the probability that a government will not default; π_t the probability that the government is the committed type; and m_t the probability that an opportunistic government will not default.

The evolution of reputation follows Bayes' rule. If the government refrains from imposing the tax, the posterior belief that the government is the committed type is:

Case 1: No Default

When the government does not default in period t, we need to determine how the probability that the government is committed evolves from π_t to π_{t+1}. This requires accounting for both Bayesian updating based on the observed action and the possibility of regime change between periods.

First, we update our belief about the government's type in period t after observing no default:

$$P(C_t|\text{No Default}) = \frac{P(\text{No Default}|C_t) \cdot P(C_t)}{P(\text{No Default})} \tag{25}$$

Since committed types never default, $P(\text{No Default}|C_t) = 1$. The prior probability that the government is committed is $P(C_t) = \pi_t$, and the total probability of no default is $P(\text{No Default}) = M_t = \pi_t + (1-\pi_t)m_t$. Therefore:

$$P(C_t|\text{No Default}) = \frac{\pi_t}{M_t} \tag{26}$$

Similarly, the probability that the government is opportunistic given no default is:

$$P(O_t|\text{No Default}) = \frac{m_t(1-\pi_t)}{M_t} \tag{27}$$

To calculate π_{t+1}, we must account for the possibility of regime change between periods t and $t+1$. The transition probabilities are:

$$P(C_{t+1}|C_t) = 1 - \epsilon_C \tag{28}$$

$$P(C_{t+1}|O_t) = \epsilon_O \tag{29}$$

Using the law of total probability:

$$\pi_{t+1} = P(C_{t+1}) = P(C_{t+1}|C_t) \cdot P(C_t|\text{No Default}) + P(C_{t+1}|O_t) \cdot P(O_t|\text{No Default}) \tag{30}$$

Substituting the values:

$$\pi_{t+1} = (1-\epsilon_C) \cdot \frac{\pi_t}{M_t} + \epsilon_O \cdot \frac{m_t(1-\pi_t)}{M_t} \tag{31}$$

This simplifies to:

$$\pi_{t+1} = \frac{\pi_t(1-\epsilon_C) + \epsilon_O m_t(1-\pi_t)}{M_t} \tag{32}$$

Where $M_t = \pi_t + (1-\pi_t)m_t$

We can simplify this expression by defining the ratio $r = \frac{\pi_t}{(1-\pi_t)m_t}$.

Substituting $\pi_t = r(1-\pi_t)m_t$ from this ratio and simplifying:

$$\pi_{t+1} = \frac{(1-\epsilon_C)r(1-\pi_t)m_t + \epsilon_O m_t(1-\pi_t)}{(1-\pi_t)m_t(r+1)} \tag{33}$$

Canceling common factors and rearranging terms:

$$\pi_{t+1} = \frac{(1-\epsilon_C)r + \epsilon_O}{r+1} \tag{34}$$

$$\pi_{t+1} = \epsilon_O + \frac{r(1-\epsilon_C-\epsilon_O)}{r+1} \tag{35}$$

Substituting back for r and simplifying:

$$\pi_{t+1} = \epsilon_O + \frac{\pi_t(1-\epsilon_C-\epsilon_O)}{(1-\pi_t)m_t+\pi_t} \tag{36}$$

Given that $(1-\pi_t)m_t + \pi_t = M_t$, we arrive at:

$$\pi_{t+1} = \epsilon_O + (1-\epsilon_C-\epsilon_O)\frac{\pi_t}{M_t} \tag{37}$$

This is the reputation update equation when the government does not default.

Case 2: Default

If the government imposes the haircut, then $\pi_{t+1} = \epsilon_O$ since only opportunistic governments default (except after regime change).

D.3.4 Derivation of Indifference Condition in dynamic reputation evolution

The Nash equilibrium implies that for the opportunistic government to employ a mixed strategy (i.e., choosing to default with some probability), it must be indifferent across strategies of defaulting or repayment. Formally this is described by comparing the opportunistic government's value functions:

$$V^{Opp}(M_t(\pi_t), 0) + \beta W_{t+1}(\pi_{t+1}) = V^{Opp}(M_t(\pi_t), \bar{\tau}) + \beta W_{t+1}(\epsilon_O) \tag{38}$$

Substituting the payoff function $V^{Opp}(M_t, \tau_t) = g(\tau_t)V(M_t)$ shows that under a mixed strategy, the government's continuation value after foregoing the haircut must obey:

$$V(M_t) + \beta W_{t+1}(\pi_{t+1}) = g(\bar{\tau})V(M_t) + \beta W_{t+1}(\epsilon_O)$$

Rearranging:

$$W_{t+1}(\pi_{t+1}) = \frac{1}{\beta}[g(\bar{\tau})-1]V(M_t(\pi_t)) + W_{t+1}(\epsilon_O) \tag{39}$$

This highlights that an opportunistic government only passes on the immediate benefit of defaulting if it receives sufficient future value from the resulting improvement in creditor beliefs about its type.

D.3.5 Derivation of Equilibrium Conditions

For the opportunistic government to employ a mixed strategy, it must be indifferent between imposing and not imposing the haircut. We have shown in the main text and appendix section D.3.4 that:

$$W_{t+1}(\pi_{t+1}) = \frac{1}{\beta}[g(\bar{\tau}) - 1]V(M_t) + W_{t+1}(\epsilon_O)$$

In the graduation-step Markov equilibrium, we have $\pi_{t+1} = \pi_{n+1}$ when $\pi_t = \pi_n$ and the government does not impose the haircut. This gives us:

$$W_{t+1}(\pi_{n+1}) = \frac{1}{\beta}[g(\bar{\tau}) - 1]V(M_n) + W_{t+1}(\epsilon_O)$$

Since $W_{t+1}(\pi_{n+1}) = V(M_{n+1}) + \beta W_{t+2}(\pi_{n+2})$ and $W_{t+1}(\epsilon_O) = V(M_0) + \beta W_{t+2}(\pi_1)$, we get:

$$V(M_{n+1}) + \beta W_{t+2}(\pi_{n+2}) = \frac{1}{\beta}[g(\tau) - 1]V(M_n) + V(M_0) + \beta W_{t+2}(\pi_1)$$

For a stationary equilibrium, we have $W_{t+2}(\pi_{n+2}) - W_{t+2}(\pi_1) = W_{t+1}(\pi_{n+1}) - W_{t+1}(\epsilon_O)$, which gives us:

$$V(M_{n+1}) = \frac{1}{\beta}[g(\bar{\tau}) - 1]V(M_n) + V(M_0)$$

Defining $\rho = (\frac{1}{\beta} - 1)[g(\bar{\tau}) - 1]$, we get:

$$V(M_{n+1}) = \rho V(M_n) + V(M_0)$$

This recursive equation characterizes the reputation cycle in the equilibrium.

D.4 Model Extension: Borrowing with Public Bond Markets

One important finding of our empirical analysis we have not addressed in the model so far, is the sharp distinction between public and private credit markets. Public bond markets represent a coordinated market structure in stark contrast to the segmented bank loan market examined so far. We now turn our attention to showing how the model framework can capture such dynamics. In the model, public bond markets are characterized by institutional investors with regulatory constraints, which as we will show, results in what resembles coordinated market exclusion post default.

D.4.1 Bond Market Structure and Participants

We assume the public bond market consists of a continuum of institutional investors indexed by $j \in [0,1]$. Unlike private creditors, these institutional investors are subject to regulatory constraints in the form of institutional investment mandates. Each institutional investor j in the bond market solves the following optimization problem:

$$\max_{D_t^{j,bond}} \bar{R}w^j + [R_t^{bond}\mathbb{E}[1-\tau_t] - \bar{R}]D_t^{j,bond} - \frac{b_{bond}}{2}\frac{(D_t^{j,bond})^2}{\omega_j^{bond}(M_t)} \tag{40}$$

The expression again consists of expected monetary returns from investments (first two terms) and a utility holding cost (final term).

D.4.2 Regulatory Constraints and Willingness Function

A key distinction between private creditors (including banks) and bond investors lies in the regulatory constraints that bond investors face. While all creditors (private and bond) observe the same π_t and form identical beliefs about $M_t = \pi_t + (1-\pi_t)m_t(\pi_t)$, we assume that bond investors are subject to investment-grade mandates that prevent participation unless M_t exceeds the *Bond Market Threshold*. Such mandates are in fact common and can be explained by frameworks like that of Diamond (1991, 1984), recognizing that bond investors face higher screening and verification costs compared to private creditors that render riskier instruments less attractive.

This regulatory constraint is reflected in the bond investors' willingness function:

$$\omega_j^{bond}(M_t) = \begin{cases} 0 & \text{if } M_t < M_{pub} \\ (M_t - M_{pub}) & \text{if } M_t \geq M_{pub} \end{cases} \tag{41}$$

Where M_{pub} is a common threshold for all institutional investors, reflecting regulatory requirements or institutional mandates. A lower threshold M_{pub} makes bond market access easier to achieve, reducing the reputation premium.

This formulation creates a coordinated "on-off" market access dynamic in line with the empirical observation of total exclusion from public bond markets following default. Unlike the private market where creditors have heterogeneous thresholds M_i, the bond market features a common threshold M_{pub} that applies to all institutional investors, creating a binary access condition:

$$\text{Bond Market Access} = \begin{cases} \text{Full Access} & \text{if } M_t \geq M_{pub} \\ \text{No Access} & \text{if } M_t < M_{pub} \end{cases} \tag{42}$$

The bond market's demand for the country's debt and the equilibrium interest rate are akin to the pendant in the private credit markets, and hence described in the Appendix.

D.4.3 Optimal Borrowing with Bond Market Access

When a sovereign has access to both private credit markets and public bond markets, it strategically sets the funding mix to maximize its objective function, whereby it also rules out any opportunity for arbitrage across markets.

With bond markets, the committed government's objective function becomes:

$$\max_{D_t^{private}, D_t^{bond}} (Q - R_t^{private}) D_t^{private} + (Q - R_t^{bond}) D_t^{bond} \tag{43}$$

Via first-order conditions with respect to $D_t^{private}$ and D_t^{bond}, we find that at the optimum[24] [25]:

$$\frac{b}{\Omega(M_t)} D_t^{private} = \frac{b_{bond}}{\Omega^{bond}(M_t)} D_t^{bond} \tag{44}$$

Proposition 2 *When the sovereign has access to both private and public bond markets, it allocates borrowing such that interest rates are equalized across markets:*

$$R_t^{private} = R_t^{bond}, \tag{45}$$

with the optimal allocation ratio given by

$$\frac{D_t^{private}}{D_t^{bond}} = \frac{b_{bond} \Omega(M_t)}{b \Omega^{bond}(M_t)} \tag{46}$$

The underlying proof to Proposition 2 can be found in the appendix. This result has important implications for understanding sovereign borrowing behavior. When a sovereign has sufficient reputation to access both markets, it will allocate borrowing to equalize the marginal cost of funds, resulting in identical interest rates. However, this access is fragile.

[24] See Appendix A for detailed derivation.

[25] Note: A lower b_B (deeper bond market) increases the discontinuity in debt capacity at M_B and strengthens the reputation premium effect.

Corollary 2.1 *Unlike in private markets, the sovereign faces total exclusion from public bond markets when $M_t < M_{pub}$.*

Corollary 2.1 highlights a critical asymmetry: unlike the immediate reaccess and partial creditor expansion in private markets driven by creditor heterogeneity, public bond markets impose a binary, coordinated exclusion when reputation falls below the common threshold M_{pub}. As a consequences, the sovereign is forced to rely exclusively on private markets: which means lower leverage, or higher cost of funds.

In summary, this extension of the model shows how creditor heterogeneity and market structure—segmented private markets versus coordinated public bond markets— shape sovereign debt dynamics. By capturing the partial exclusion in private markets and the total exclusion in public bond markets, the framework offers an alternative to the traditional binary view of market exclusion and underscores the critical role of market structure in determining the costs of default.

D.4.4 Derivation of Optimal Borrowing Allocation with Bond Markets

Bond Market Demand and Equilibrium

From the first-order condition for institutional investor j:

$$[R_t^{bond}(1-(1-M_t)\bar{\tau})-\bar{R}] - \frac{b_{bond} D_t^{j,bond}}{\omega_j^{bond}(M_t)} = 0 \tag{47}$$

Solving for $D_t^{j,bond}$:

$$D_t^{j,bond} = \begin{cases} \frac{\omega_j^{bond}(M_t)}{b_{bond}}[R_t^{bond}(1-(1-M_t)\bar{\tau})-\bar{R}] & \text{if } M_t \geq M_{pub} \\ 0 & \text{if } M_t < M_{pub} \end{cases} \tag{48}$$

Total demand in the bond market must equal supply:

$$D_t^{bond} = \int_{j=0}^{1} D_t^{j,bond} dj = \int_{j=0}^{1} \frac{\omega_j^{bond}(M_t)}{b_{bond}}[R_t^{bond}(1-(1-M_t)\bar{\tau})-\bar{R}]dj \tag{49}$$

For notational simplicity, define:

$$\Omega^{bond}(M_t) = \int_{j=0}^{1} \omega_j^{bond}(M_t) dj \tag{50}$$

Solving for the equilibrium interest rate:

$$R_t^{bond} = \frac{\bar{R} + \frac{b_{bond} D_t^{bond}}{\Omega^{bond}(M_t)}}{1 - (1 - M_t)\bar{\tau}} \tag{51}$$

This holds when $M_t \geq M_{pub}$. When $M_t < M_{pub}$, the bond market is inaccessible.

Interest Rates across Debt Markets

In this appendix, we derive the optimal allocation of borrowing between private and public bond markets and prove that interest rates will be equalized at the optimum.

The government's objective function when it has access to both markets is:

$$\max_{D_t^{private}, D_t^{bond}} (Q - R_t^{private}) D_t^{private} + (Q - R_t^{bond}) D_t^{bond} \tag{52}$$

Subject to the interest rate determination in each market:

$$R_t^{private} = \frac{\bar{R} + \frac{b D_t^{private}}{\Omega(M_t)}}{1 - (1 - M_t)\bar{\tau}} \tag{53}$$

$$R_t^{bond} = \frac{\bar{R} + \frac{b_{bond} D_t^{bond}}{\Omega^{bond}(M_t)}}{1 - (1 - M_t)\bar{\tau}} \tag{54}$$

Taking the first-order conditions:

For $D_t^{private}$:

$$\frac{\partial}{\partial D_t^{private}} [(Q - R_t^{private}) D_t^{private}] = 0 \tag{55}$$

Expanding:

$$Q - R_t^{private} - \frac{\partial R_t^{private}}{\partial D_t^{private}} D_t^{private} = 0 \tag{56}$$

For D_t^{bond}:

$$\frac{\partial}{\partial D_t^{bond}} [(Q - R_t^{bond}) D_t^{bond}] = 0 \tag{57}$$

Expanding:

$$Q - R_t^{bond} - \frac{\partial R_t^{bond}}{\partial D_t^{bond}} D_t^{bond} = 0 \tag{58}$$

Computing the derivatives:

$$\frac{\partial R_t^{private}}{\partial D_t^{private}} = \frac{\partial}{\partial D_t^{private}} \left[\frac{\bar{R} + \frac{bD_t^{private}}{\Omega(M_t)}}{1-(1-M_t)\bar{\tau}} \right] = \frac{b}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} \tag{59}$$

$$\frac{\partial R_t^{bond}}{\partial D_t^{bond}} = \frac{\partial}{\partial D_t^{bond}} \left[\frac{\bar{R} + \frac{b_{bond}D_t^{bond}}{\Omega^{bond}(M_t)}}{1-(1-M_t)\bar{\tau}} \right] = \frac{b_{bond}}{\Omega^{bond}(M_t)(1-(1-M_t)\bar{\tau})} \tag{60}$$

Substituting back into the first-order conditions:

$$Q - R_t^{private} - \frac{b}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} D_t^{private} = 0 \tag{61}$$

$$Q - R_t^{bond} - \frac{b_{bond}}{\Omega^{bond}(M_t)(1-(1-M_t)\bar{\tau})} D_t^{bond} = 0 \tag{62}$$

Rearranging:

$$Q - R_t^{private} = \frac{b}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} D_t^{private} \tag{63}$$

$$Q - R_t^{bond} = \frac{b_{bond}}{\Omega^{bond}(M_t)(1-(1-M_t)\bar{\tau})} D_t^{bond} \tag{64}$$

For an interior solution where the government borrows from both markets, these expressions must be equal:

$$\frac{b}{\Omega(M_t)(1-(1-M_t)\bar{\tau})} D_t^{private} = \frac{b_{bond}}{\Omega^{bond}(M_t)(1-(1-M_t)\bar{\tau})} D_t^{bond} \tag{65}$$

Simplifying:

$$\frac{b}{\Omega(M_t)} D_t^{private} = \frac{b_{bond}}{\Omega^{bond}(M_t)} D_t^{bond} \tag{66}$$

This gives us the optimal allocation ratio:

$$\frac{D_t^{private}}{D_t^{bond}} = \frac{b_{bond}\Omega(M_t)}{b\Omega^{bond}(M_t)} \tag{67}$$

To verify that interest rates are equal at this optimal allocation, we substitute the interest rate expressions:

$$R_t^{private} = R_t^{bond} \tag{68}$$

$$\frac{\bar{R} + \frac{bD_t^{private}}{\Omega(M_t)}}{1-(1-M_t)\bar{\tau}} = \frac{\bar{R} + \frac{b_{bond}D_t^{bond}}{\Omega^{bond}(M_t)}}{1-(1-M_t)\bar{\tau}} \tag{69}$$

Since the denominators are identical, this simplifies to:

$$\bar{R} + \frac{bD_t^{private}}{\Omega(M_t)} = \bar{R} + \frac{b_{bond}D_t^{bond}}{\Omega^{bond}(M_t)} \tag{70}$$

Further simplifying:

$$\frac{bD_t^{private}}{\Omega(M_t)} = \frac{b_{bond}D_t^{bond}}{\Omega^{bond}(M_t)} \tag{71}$$

This is exactly the condition we derived from the optimal allocation ratio. Therefore, at the optimal allocation, interest rates will indeed be equal across markets.