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Can participation in IMF programs facilitate sovereign debt rescheduling? The role of program size

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ABSTRACT

We develop a theoretical model to explain the possible inverted U-shaped relationship between IMF loan size and the probability of sovereign debt rescheduling. Given that the IMF is a *de facto* senior creditor, borrowing too much from the IMF leaves a smaller total surplus for the debtor and creditor to share in the future; thus creditors and debtors have less incentive to renegotiate the debt. Empirically, we propose a new identification strategy to isolate the effect of IMF loan size. Our identification strategy is based on Bartik-style instrumental variables that combine changes in the IMF's liquidity and the country's historical average IMF loan size. Using panel data from 100 countries over the period between 1977 and 2020, we empirically demonstrate the inverted U-shaped relationship predicted by our theory. While our results confirm the positive role of IMF loans in resolving sovereign debt crises, we note that too much lending can lead to unintended adverse outcomes.

1. Introduction

The Covid-19 pandemic triggered debt distress in several developing and emerging economies. Tax revenues collapsed due to the suspension of economic activity, while governments were forced to spend on tackling the pandemic. Such budget deficits made sovereign debt unsustainable. Although the G20 countries, the International Monetary Fund (IMF), the World Bank, and the Paris Club committed to a Debt Service Suspension Initiative (DSSI) which temporarily suspended debt service payments throughout the years 2020 and 2021, many poorer countries may still struggle to service outstanding debt in the medium run (Stiglitz and Rashid, 2020). For example, Sri Lanka and Zambia defaulted on their external debt payments during the pandemic. In fact, many developing countries were already in debt trouble before the advent of Covid-19. According to an IMF report released in February 2020 (International Monetary Fund, 2020), half of low-income countries were at high risk of debt distress or were already in distress.

When a country is in debt distress, a debt overhang effect is created, whereby the debtor nation is reluctant to invest and generate income to repay the debt because most of its income goes to its creditors. This can create a lose-lose situation for debtors and their creditors (Krugman, 1988). The primary tool for resolving debt distress is debt rescheduling, which can be defined as the exchange of outstanding sovereign instruments for new debt instruments through a legal process. This exchange modifies the financial structure of the liabilities to reduce the net present value of the debt (World Bank, 2022). Thus, debt rescheduling implies debt relief and usually involves a reduction in the repayments (Das et al., 2012). It can reduce the debt overhang effect, boosting the debtor's incentive to

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invest and eventually repay the debt. Thus, it can be described as a Pareto-improving strategy (Krugman, 1988). Empirically, Reinhart and Trebesch (2016) show that the economic condition of debtor countries improves significantly after receiving a sufficient amount of debt relief.

Although debt rescheduling can benefit both creditors and debtors, negotiation can be complex and costly process. The complexity arises from the incentive, coordination and information asymmetry problems. The debtor always has an incentive to ask the creditor to reduce the debt. In addition, the success of economic recovery requires both debt relief and efforts from the debtor, including fiscal retrenchment and structural reform (Reinhart and Trebesch, 2016). However, the debtor may not be interested in making adjustments, since such actions are costly and politically constrained. Thus, in the presence of information asymmetry, whereby the creditors have imperfect knowledge regarding the attributes and potential actions of the debtor, debt rescheduling may only benefit the debtor and reduce the welfare of the creditors. Coordination among the creditors is a major challenge for debt rescheduling, since the debtor needs to convince a sufficiently large share of the creditors to participate in a debt exchange at a loss (or haircut) (Fang et al., 2021). At the same time, there is a free-rider problem, as each creditor has an incentive not to participate in the haircut but to benefit from the haircuts of other creditors. This can lead to low rates of participation in debt rescheduling, and is known as the holdout problem.

International financial institutions like the IMF can play a constructive role in facilitating sovereign debt rescheduling and resolving incentive issues. The IMF can provide loans to countries facing financial shortfalls when other lending sources are unavailable. These loans often come with conditions designed to help the country implement credible and sound economic policies (Rogoff, 2022). Such conditions impose costs associated with economic reform. Due to the cost attached to IMF loans, Marchesi and Thomas (1999) argue that participation in an IMF program can be used as a screening device, enabling a creditor to discriminate between debtor countries when there is hidden information. Only countries that need help and are willing to make adjustments choose to participate in IMF programs. These countries are good candidates for debt rescheduling, which is beneficial for both debtors and creditors. The Paris and London Clubs were set up to ensure timely, orderly and equitable debt relief for countries experiencing difficulties in repaying their debt.[1] According to Fuentes and Saravia (2010), the Paris Club is an organization of official creditors that meets several times a year to negotiate restructuring of sovereign debt. Creditor governments conduct debt rescheduling negotiations of official bilateral debt with sovereign debtors in a coordinated manner. Private creditors, such as banks and other commercial lending institutions, generally reschedule their credits to the debtor country in the London Club. A core component of the London Club is the Bank Advisory Committee, which aims to overcome coordination problems among hundreds of individual banks (Das et al., 2012). A steering committee of bankers acts as an advisory and liaison group to all bank creditors. Before commencing debt negotiation in the Paris Club, the debtor country is required to participate in an IMF program. Although this is not a strict requirement for negotiation in the London Club, it is nonetheless often required by private creditors. Thus, participating in an IMF program facilitates debt renegotiation in both the Paris and London Clubs and partially resolves the holdout problem.

Although the existing literature has shown that participation in an IMF program increases the probability of debt rescheduling (Marchesi, 2003), the role of loan size is overlooked. Previous studies have demonstrated the importance of IMF loan size. For example, Krahnke (2023) shows that the catalytic effect of IMF lending on private capital flows may be weakened if the loan size exceeds a certain threshold. Papi et al. (2015) show that IMF lending can reduce the probability of future banking crises if the loan size is sufficiently large. This study contributes to the literature by providing insight into the effect of IMF loan size on the probability of debt rescheduling from both theoretical and empirical perspectives. Marchesi and Thomas (1999) develop a theoretical model to show that participating in an IMF program can signal a debtor country's willingness to reform, which is rewarded with debt rescheduling. Unlike Marchesi and Thomas, who focus on the adverse selection problem, we develop a simple theoretical model highlighting the incentive issues of debtors and creditors during debt rescheduling negotiations. This model is useful in explaining the non-linear relationship between IMF loan size and the probability of sovereign debt rescheduling. The success of debt rescheduling depends on the interplay between creditors and debtors. Participation in an IMF program can partially resolve some of the incentive issues highlighted above. The debtor and creditor can cooperate to renegotiate the outstanding debt and share the surplus. However, since the IMF is a *de facto* senior creditor, more borrowing from the IMF means that there is less surplus left for the creditor and debtor to share in the future. This reduces the incentives of both parties to renegotiate the debt. Second, this is the first paper to empirically test the effect of IMF loan size on the probability of debt rescheduling. We show that there is an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. This is consistent with our theoretical prediction. In addition, we offer a new identification strategy to isolate the effect of IMF loan size. Inspired by methodological innovations from other studies (Nunn and Qian, 2014; Gehring and Lang, 2020; Lang, 2021), our identification strategy is based on Bartik-style instrumental variables (IV) that combine changes in the IMF's liquidity and the country's historical average IMF loan size. This instrument is a new IV that has not yet been used in the literature.

Our paper is related to the sovereign debt regeneration theory in terms of bargaining between creditors and debtors. Bai and Zhang (2012) show that asymmetric information is the reason for delays in sovereign debt rescheduling agreements. Lack of commitment is extensively explored by Benjamin and Wright (2009). In their model, creditors are concerned about their ability to share in the future surplus, which is threatened by the risk that the debtor will default on the agreement. Delays in reaching an agreement can also be caused by economic recovery and sustainability considerations (Ghosal et al., 2019), the business cycles of risk averse creditors (Asonuma and Joo, 2020), and fiscal constraints in the debtor country (Asonuma and Joo, 2021). Other studies focus on coordination problems among multiple creditors (see, among others, Kletzer, 2003; Ghosal and Miller, 2003; Weinschelbaum and Wynne, 2005; Pitchford and Wright, 2012; Ghosal and Thampanishvong, 2013; Ghosal and Miller, 2015). However, we did not model the creditor

[1] For further information about the renegotiation process at the Paris and London Clubs, see Das et al. (2012).

holdout problem explicitly in our study.

The empirical section of this paper builds on prior research into the determinants of sovereign debt rescheduling (see, among others, Eaton and Gersovitz, 1981; Lloyd-Ellis et al., 1989; Lloyd-Ellis et al., 1990; Lee, 1991; Rahnama-Moghadam et al., 1991; Bäcker, 1992; Marchesi, 2003; Chauvin and Kraay, 2007; Freytag and Pehnelt, 2009; Laušev et al., 2011; Das et al., 2012; Cheng et al., 2016) and the effects of participating in IMF programs. Previous studies have shown that participating in IMF programs affects economic outcomes (Przeworski and Vreeland, 2000; Evrensel, 2002; Dreher and Vaubel, 2004; Barro and Lee, 2005; Butkiewicz and Yanikkaya, 2005; Dreher, 2006), capital flows (Van der Veer and de Jong, 2010; Krahnke, 2023), capital accumulation (Nemlioglu and Mallick, 2020), sovereign credit ratings (Gehring and Lang, 2020), and inequality (Lang, 2021), as well as impacting the likelihood of currency crisis (Dreher and Walter, 2010) and sovereign debt crisis (Jorra, 2012).

Using annualized panel data from 100 countries over the period between 1977 and 2020, we find that the probability of debt rescheduling is positively associated with IMF loan size and negatively associated with the square term of IMF loan size. This indicates an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. Our results are robust to various estimation strategies (OLS, fixed effect model, IV regression and probit regression), different types of creditors, different lag structures, alternative instruments, and different subsamples.

The remainder of the paper is organized as follows: Section 2 develops the theoretical framework. Section 3 explains the empirical methodology and data. Section 4 presents the empirical results and robustness check. Finally, section 5 concludes the paper.

2. Theoretical framework

In this section, we present a simple model of the interaction between the debtor and the creditors. At date 0, a country (debtor) holds E amount of debt that has matured, but the country is facing difficulties in paying it back. Thus, the country is trying to renegotiate with multiple creditors to extend the maturity of the debt and reduce it by x amount. The country's output at date 1 is Y. If the negotiations are successful, the country pays its creditor $sE-x$ and receives $Y-(E-x)$. If the negotiations fail, we assume that the creditor gets nothing. Given that a fundamental problem with sovereign default is the lack of a legal enforcement mechanism (Önder, 2016), the creditor cannot seize the asset from the debtor country. Instead, the creditor can put sanctions on the country which lead to a decrease in the country's output. In this case, the country's output would be αY, where $0<\alpha<1$. We further assume that both debtors and creditors are risk-neutral.

The probability of successful negotiation $\theta(C,D)$ depends on the efforts of the creditors and the debtor. Let $C\in[0,\bar{U}]$ represent the collective efforts of the creditors, and $D\in[0,\bar{U}]$ represent the effort of the debtor, with each participant's effort level bounded by a finite value $\bar{U}$. Let $N(D)$ be the cost of effort for the debtor, e.g. the costs of economic adjustment. Let $M(C)$ be the cost of effort for the creditors, e.g. the coordination costs among creditors. Assume both cost of effort functions are strictly increasing convex functions with $M(0)=0$ and $N(0)=0$. The probability of successful negotiation is $0\le\theta(C,D)\le 1$, where $\theta(.)$ is continuously differentiable with

$$\frac{\partial\theta(C,D)}{\partial C}>0,\frac{\partial\theta(C,D)}{\partial D}>0,\frac{\partial^2\theta(C,D)}{\partial C^2}\le 0 and\frac{\partial^2\theta(C,D)}{\partial D^2}\le 0 \tag{1}$$

That is, the probability of successful negotiation increases with the efforts of debtors and creditors at a decreasing rate. We assume that C and D are strategic complements, implying that the cross partial derivative of the function θ, $\frac{\partial^2\theta(C,D)}{\partial C\partial D}$, is positive.[2] An increase in the effort level of one party enhances the marginal effectiveness of the other party's effort.

The creditor's optimization problem is choosing an effort level C to maximize the payoff:

$$V(C,D)=\theta(C,D)(E-x)-M(C) \tag{2}$$

The debtor's optimization problem is choosing an effort level D to maximize the payoff:

$$W(C,D)=\theta(C,D)[Y-(E-x)]+[1-\theta(C,D)]\alpha Y-N(D) \tag{3}$$

The solution is given by the first-order conditions:

$$\theta_C(C,D)(E-x)=M'(C) \tag{4}$$

$$\theta_D(C,D)[(1-\alpha)Y-(E-x)]=N'(D) \tag{5}$$

This is the non-cooperative Nash equilibrium, in which the debtor and the creditor choose their effort levels independently. We denote the non-cooperative Nash equilibrium effort levels as C^* and D^*.

To ensure the existence of an interior solution, we assume:

$$\lim_{C\to 0}V_C(C,D)>0\forall D,\lim_{C\to U}V_C(C,D)<0\forall D$$

[2] Even if we assume C and D are strategically independent, our propositions hold.

$$\lim_{D\to 0} V_D(C,D) > 0 \forall S, \lim_{D\to U} V_D(C,D) < 0 \forall C$$

At date 0, the debtor has another choice. They can obtain loan L from the IMF and pay back RL to the IMF at date 1. Following Corsetti et al. (2006), we assume that IMF loans are senior to all other debt. Schlegl et al. (2019) have empirically confirmed the *de facto* seniority status of IMF loans. The objective function of the debtor becomes:

$$U(C,D) = \theta(C,D)[Y - RL - (E - x)\,] + [1 - \theta(C,D)]\alpha Y - N(D) \tag{6}$$

By joining the IMF program, we assume that creditors and debtors can cooperate more effectively and share a common goal. This is a plausible assumption. Although the IMF is not directly involved in debt restructuring decisions or negotiations with other creditors, it can facilitate the negotiation and restructuring process to resolve the following issues:

1) Procrastination and lack of financing: The debtor government is often reluctant to announce negotiations, as it could send a bad signal and result in loss of access to the credit market. Delays to the process may mean that economic conditions worsen. With the help of IMF loans, the government has an incentive to renegotiate the debt sooner.

2) Information asymmetry: The debtor holds complete information about their total debt and capacity to repay but the creditors do not have the full picture. This can create distrust with creditors. The IMF always carries out detailed investigations about the country's debt sustainability when the latter requests it for funding projects. Often, it shares such information about the country with other creditors.[3] This information helps the creditors to arrive at an estimate for the minimum debt relief needed by the country and often serves as a benchmark for negotiation.

3) Lack of commitment: For countries in receipt of debt relief, it is important that they commit to reform the policies that created unsustainable debt levels. Conditions are attached to IMF loans and they are paid out in tranches over time, as and when the government meets specific reform milestones. Thus, IMF involvement helps with the implementation of policy reforms as well.

4) Lack of coordination: During the debt negotiation process, the IMF supports a negotiation strategy that leads to a high creditor participation rate and requires the debtor country to negotiate in good faith. In addition, once the debtor country joins the IMF program, negotiations can take place in either the Paris Club or the London Club. With the involvement of the IMF, the Paris Club, and the London Club, coordination between creditors and debtors becomes easier and part of the creditors' coordination problem is resolved.

Thus, after joining the IMF program, the creditor and the debtor play a cooperative game whereby they choose their effort levels to maximize their joint payoffs:

$$V(C,D) + U(C,D) = \theta(C,D)[Y - RL - (E - x) + (E - x)\,] + [1 - \theta(C,D)\,]\alpha Y - M(C) - N(D) \tag{7}$$

The cooperative effort choices of the creditor and debtor, C^{**} and D^{**}, are given by the solution of the first-order conditions:

$$\theta_C(C,D)[(1-\alpha)Y - RL] = M'(C) \tag{8}$$

$$\theta_D(C,D)[(1-\alpha)Y - RL] = N'(D) \tag{9}$$

Proposition 1. There exists a threshold value for RL, such that If $RL < min[(1-\alpha)Y-(E-x), (E-x)]$ then $C^{**}>C^{*}$ *and* $D^{**}>D^{*}$.

Proof. We first show that under the condition of strategic independence, $\theta_{CD}(C,D) = 0$ and $\theta_{DC}(C,D) = 0$, our proposition holds. Comparing equations (8) and (4), given that the cost of effort function M(C) is convex, if $(1-\alpha)Y-RL > (E-x)$ or $RL < (1-\alpha)Y-(E-x)$, then C**>C*. Comparing equations (9) and (5), given that the cost of effort function N(D) is convex, if $(1-\alpha)Y-RL > [(1-\alpha)Y-(E-x)]$ or $RL < (E-x)$, then D**>D*. Under the condition of strategic complement, $\theta_{CD}(C,D) > 0$ and $\theta_{DC}(C,D) > 0$, $\theta_C(C,D)$ in equation (8) is larger than in equation (4), and $\theta_D(C,D)$ in equation (9) is larger than in equation (5), our proposition is strengthened.[4]

Lemma 1. As RL becomes larger, C^{**} and D^{**} will become smaller.

Proof. From the first-order conditions of the cooperative game, if RL is larger, C** and D** will be smaller.

Proposition 2. As the face value of the IMF loan becomes larger, debt rescheduling is less likely.

The intuition of Propositions 1 and 2 is as follows. Debt renegotiation between creditors and debtors can be a cooperative game if the debtor enters an IMF program. Providing that the debtor does not borrow too much from the IMF, that is, there is enough surplus left for the creditor and debtor to share in the future, both parties will put greater effort into negotiating than if the debtor has not entered an IMF program. Therefore, debt rescheduling is more likely if the debtor country is participating in an IMF program. However, if the debtor country borrows more from the IMF, there is less surplus left for the creditor and debtor to share in the future, and both parties have less incentive to negotiate debt rescheduling. Thus, based on Propositions 1 and 2, we conjecture that there is an inverted

[3] For further information about IMF information sharing, please read International Monetary Fund (2023a), "Staff guidance note on information sharing in the context of sovereign debt restructurings".

[4] Please note that the threshold value of RL, $\bar{RL} = min[(1-\alpha)Y-(E-x), (E-x)]$, is derived based on the strategic independence condition. Assuming strategic complements, it is possible that $C^{**}>C^{*}$ *and* $D^{**}>D^{*}$ even if RL exceeds the threshold value $\bar{RL}$. This is because $\theta_C(C,D)$ in equation (8) is larger than in equation (4), and $\theta_D(C,D)$ in equation (9) is larger than in equation (5). The possible change of threshold value $\bar{RL}$ does not affect our conclusion and hypothesis.

U-shaped relationship between IMF loan size and the probability of debt rescheduling.[5] *This leads to the following testable hypothesis:*

Hypothesis 1: There is an inverted U-shaped relationship between the amount of IMF loans and the probability of sovereign debt rescheduling.

3. Data and empirical strategy

3.1. Research sample and data sources

The annual data span the years 1977 to 2020 and include a maximum of 100 developing countries. We denote a rescheduling deal with private creditors (foreign banks and bondholders) as "private debt rescheduling", while "official debt rescheduling" refers to agreements reached with official creditors. The debt rescheduling is defined as the final agreement with either official or private external creditors. Data on debt restructuring agreement dates are readily available from the Paris Club website and Asonuma and Trebesch's (2016) private restructuring database. Table 1 shows the number of debt rescheduling cases during subsample periods. Over the period from 1977 to 2020, 428 official debt rescheduling cases and 159 private debt rescheduling cases occurred.

Following the previous literature, we take into account all types of IMF loans, including non-concessional loans, financed via the General Resources Account (GRA), and concessional loans, supported by the Poverty Reduction and Growth Trust (PRGT, which replaced the Poverty Reduction and Growth Facility—PRGF). IMF loan data are collected from the IMF historical data set. Country-specific economic and political data are taken from various sources such as the World Bank database and the Database of Political Institutions. Table 2 contains detailed information.

3.2. Specification of the empirical model

According to the theoretical model in Section 2, we conjecture that there is an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. Thus, we use the following quadratic model to capture the inverted U-shaped relationship:

$$Debt\ Rescheduling_{it} = \alpha_0 + \alpha_1 IMF\ Loan_{i(t-5,t-1)} + \alpha_2 IMF\ Loan^2_{i(t-5,t-1)} + \alpha_3 Controls_{it-1} + \eta_i + \tau_t + \varepsilon_{it} \quad (10)$$

where $Debt\ Rescheduling_{it}$ is a dummy variable that takes a value of one if sovereign debt is rescheduled in country i at time t. Following Papi et al. (2015), we define our variable of interest, $IMF\ loan_i$, as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of $IMF\ Loan_i$ is also included. The model controls for factors that could impact the likelihood of debt rescheduling. *Controls* is a vector of macroeconomic variables with a one-year lag. In particular, we control for the total debt service to exports ratio, the total external debt stock to GDP ratio, the current account to GDP ratio, the ratio of total reserves minus gold to imports of goods and services, and the ratio of exports of goods and services to imports of goods and services. We also control for GDP per capita, the gross domestic investment to GDP ratio, interest and principal arrears to long-term external debt stocks. The list of variables, their labels, definitions, sources, and summary statistics are reported in Table 2. η_i denotes country fixed effects which control for unobserved time-invariant country characteristics. τ_t denotes year fixed effects which control for year-specific global shocks. ε_{it} is the error term.

3.3. The identification strategy

The goal of this paper is to analyze the effect of the IMF loan size of a recipient country on its probability of sovereign debt rescheduling. The main issue for this research question is that selection into IMF programs and loan size are not random. Deterioration in economic conditions may have an impact on both IMF loan size and the likelihood of sovereign debt rescheduling. As a result, omitted variable bias challenges the estimation of the causal effect of IMF loan size on the probability of debt rescheduling. Not all potential confounding factors are observable, so it is not sufficient to address the endogeneity problem by controlling for macroeconomic conditions. Ideally, we need a mechanism that randomly assigns a certain loan amount to countries on comparable trajectories. Our approach is to employ an IV that changes a particular country's IMF loan size but is unrelated to the country's probability of debt rescheduling.

Causality inference requires the assumption that our IV only influences the probability of debt rescheduling through IMF lending. IMF liquidity, which measures the amount of liquid resources that are available to the IMF in a given year, is a good IV candidate.

[5] Alternatively, we could model output Y as an increasing concave function of the IMF loan L, e.g. output is a production function of capital. We could still show the inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. However, the critical point for the U-turn would be higher under the case of endogenous output. Given that we are interested in showing the inverted U-shaped relationship but not the turning point, our conclusion still holds. For the sake of simplicity and focusing on the main concept of the model, we use exogenous output in this study.

Table 1
Distribution of debt rescheduling cases.

	Official	Private	Total
Middle-income countries countries			
1977–1980	4	6	10
1981–1990	81	55	136
1991–2000	99	37	136
2001–2010	49	16	65
2011–2020	28	10	38
Total	261	124	385
Low-income countries			
1977–1980	7	2	9
1981–1990	59	21	80
1991–2000	38	7	45
2001–2010	46	1	47
2011–2020	17	4	21
Total	167	35	202
Whole Sample	428	159	587

Note: This table shows the number of debt rescheduling cases across various subsample periods from 1977 to 2020. "Official" stands for agreements reached with official creditors, while "Private" represents a rescheduling deal with private creditors (foreign banks and bondholders). The debt rescheduling is defined as the final agreement with either official or private external creditors.

Conceptually, such an identification strategy compares the probability of debt rescheduling in developing countries in years after IMF liquidity is high to the probability in years after it is low. However, if there are other unobserved factors that change over time and are spuriously correlated with debt rescheduling and IMF lending, the exclusion restriction is not satisfied. This problem can be addressed by including time fixed effects. However, since IMF liquidity only varies over time, it will be collinear with time fixed effects. Following Nunn and Qian (2014), Gehring and Lang (2020), and Lang (2021), we interact IMF liquidity with a variable that measures cross-sectional variations. Previous research has found that a country's prior involvement in IMF programs is a strong predictor of current involvement in IMF programs (Bird et al., 2004; Sturm et al., 2005). Thus, Gehring and Lang (2020), Lang (2021), and Bomprezzi and Marchesi (2023) interact IMF liquidity with IMF probability, which reflects the country's history of participating in IMF programs.[6] Whereas their studies investigate the effect of participating in IMF programs, we are analyzing the effect of IMF loan size. Thus, we interact IMF liquidity with the historical average IMF loan size of the recipient country. That is, the effect of prior IMF loan size on current IMF loan size differs conditionally on IMF liquidity. Specifically, in years of relatively low IMF liquidity, IMF resources tend to be allocated to countries that have received more IMF loans in the past. The reasons include path dependency and "recidivism" of recipient countries (Bird et al., 2004), political favoritism of the main contributors (Copelovitch, 2010; Thacker, 1999), and staff incentives and preferences (Nelson, 2014). Accordingly, the historical average IMF loan size is a strong predictor of more recent IMF loan amounts. However, during years of relatively high IMF liquidity, a country's historical engagement is much less important. International bureaucracies are committed to maximizing their budgets, remits, staff, relevance, and political influence. When liquidity is high, substantial amounts of allocable resources provide them with financial opportunities to expand beyond their regular clientele (Vaubel, 2006). Based on this discussion, we construct the following IV:

$$IV = HistoricalIMFLoan \times IMF\ liquidity \tag{11}$$

Historical IMF Loan is the historical average IMF loan size of a country and is measured by the average of past annual IMF loan-to-GDP ratios since the start of the observation year.[7] *IMF liquidity* is the IMF's ratio of liquid assets to liquid liabilities, and determines the amount of available resources for IMF programs in a given year. Given that we are predicting the accumulated agreed IMF loans in the past five years, instead of using one year's IMF liquidity, we use the average of the past five years. IMF liquidity data are collected from IMF Annual Reports. Given that we are investigating the non-linear relationship, we also include an endogenous square term (IMF loan squared). If *IV* in equation (11) is a good instrument for *IMF Loan*, then *IV* squared is a good instrument for *IMF Loan* squared (Angrist and Pischke, 2009; Haans et al., 2016).

We run two-stage least squares (2SLS) panel regressions as follows:

First stage:

$$\begin{aligned} IMF\ Loan_{i(t-5,t-1)}\left(orIMF\ Loan^{2}_{i(t-5,t-1)}\right) = {} & \alpha_1\left(HistoricalIMFLoan_{i(1971,t-6)} \times IMF\ liquidity_{i(t-5,t-1)}\right) \\ & + \alpha_2\left(HistoricalIMFLoan_{i(1971,t-6)} \times IMF\ liquidity_{i(t-5,t-1)}\right)^2 + \alpha_3 HistoricalIMFLoan_{i(1971,t-6)} \\ & + \alpha_4 Controls_{it-1} + \eta_i + \tau_t + \varepsilon_{it} \end{aligned} \tag{12}$$

[6] It is the ratio of the number of years a country is under an IMF program to the total number of years between the starting year and year t.
[7] This variable not only captures the historical probability of participating in an IMF program, but also captures the size of the loan.

Table 2
Variables definitions, sources, and summary statistics.

Variable	Definition	Sources	Mean	SD	Min	Median	Max
Debt Rescheduling	A dummy variable is equal to one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise	Private debt rescheduling data are from Asonuma and Trebesch's (2016) database; Official debt rescheduling data are from Paris Club website	0.104	0.305	0	0	1
Official debt rescheduling	A dummy variable is equal to one for country-year observations in which there is an official debt rescheduling, and zero otherwise	Paris Club website	0.080	0.271	0	0	1
Private debt rescheduling	A dummy variable is equal to one for country-year observations in which there is a private debt rescheduling, and zero otherwise	Asonuma and Trebesch (2016, updated dataset)	0.036	0.186	0	0	1
IMF Loan	The logarithm of 1 + the IMF loan amount approved in the previous five-year period, as a share of GDP. The variable equals zero if the country has not signed any agreement in the previous five-year period. In multiple agreement cases, the loan-to-GDP ratios are added together	IMF historical data set and World Development Indicators	0.780	0.895	0	0.526	4.095
IMF Liquidity	IMF liquidity ratio, equals liquid resources divided by liquid liabilities. We use the average IMF liquidity ratio from the past five years.	IMF's Annual Reports	5.334	0.765	3.491	5.109	7.109
Historical IMF Loan	$Ln\left(1+\frac{\sum_{T=1971}^{t}\frac{\text{Loan}}{\text{GDP}}}{t-1971}\right)$	IMF historical data set and World Development Indicators	0.329	0.332	0	0.256	2.231
TDS	Total debt service to exports ratio	World Development Indicators	0.180	0.153	0.000	0.139	1.569
EDT	Total external debt stock to GDP ratio	World Development Indicators	0.564	0.534	0.025	0.438	10.874
CA	Current Account to GDP ratio	World Development Indicators	−0.04	0.098	−0.650	−0.035	2.384
RES	Total reserves minus gold to imports of goods and services	World Development Indicators	0.541	5.325	0.000	0.293	192.267
EXP	Ratio of exports of goods and services to Imports of goods and services	World Development Indicators	1.046	7.409	0.073	0.794	295.620
GDPPC	GDP per capita, in constant 000 USD	World Development Indicators	2.328	2.467	0.100	1.354	15.975
GDI	Gross domestic investment to GDP ratio	World Development Indicators	23.714	8.892	−5.740	22.526	89.381
IAR	Interest arrears to long-term external debt	World Development Indicators	0.024	0.099	0.000	0.001	2.283
PAR	Principal arrears to long-term external debt	World Development Indicators	0.046	0.114	0.000	0.002	1.247
Polity IV	Polity score, based on six measures that record key qualities of executive recruitment, constraints on executive authority, and political competition. The index is part of the Polity IV project and ranges from − 10 (hereditary monarchy) to + 10 (consolidated democracy).	Marshall et al., (2010, updated)	2.058	6.329	−10	5	10
Left government	The ruling party's political ideology and equals to 1 if the government is left and zero otherwise	Database of Political Institutions	0.279	0.449	0	0	1
Election	A dummy variable is equal to one if an election took place and zero otherwise	Database of Political Institutions	0.172	0.377	0	0	1
Honeymoon	The government's number of years in office	Database of Political Institutions	7.299	7.751	1	4	46
Soundmoney	An index consisting of the following indicators: (i) Average annual growth of the money supply in the last five years minus average, (ii) annual growth of real GDP in the last 10 years, (iii) Standard inflation variability in the last five years, (iv) Recent inflation rate, and (v) Freedom to own foreign currency bank accounts domestically and abroad	Fraser Institute	6.980	1.989	0.000	7.07	9.88
Country risk	The Composite Index published by the International Country Risk Guide (ICRG)	International Country Risk Guide	62.105	9.733	22	63.896	84.479
FINANCIAL OPENNESS	The Chinn-Ito de jure measure of financial openness	Chinn and Ito (2008, updated)	0.358	0.308	0.000	0.164	1
World GDP Growth	Annual growth rate of real GDP of the world. We use the average of the past five years.	World Development Indicators	2.915	1.549	−3.363	3.168	4.677
Global Bank Crises	The number of systemic banking crisis in a year. We use the total number in the past five years.	Laeven and Valencia (2012, updated)	1.976	1.080	0	2.197	3.434
UNGA Voting	UNGA voting similarity to the United States. We use the average of the past five years.	Bailey et al. (2017)	−0.311	0.557	−1.987	−0.361	1.914
Creditor Committee	A dummy variable is equal to one for country-year observations in which there is a debt rescheduling with ac creditor committee, and zero otherwise	Asonuma and Joo (2020)	0.025	0.156	0	0	1
Creditor Committee Chair	A dummy variable is equal to one for country-year observations in which there is a debt rescheduling with ac creditor committee chair, and zero otherwise	Asonuma and Joo (2020)	0.023	0.149	0	0	1

Notes: Summary statistics are calculated on the sample of 100 countries used in the empirical analysis for the period from 1977 to 2020. Mean, standard deviation, minimum value, median, and maximum value are reported.

Second stage:

$$Debt\ Rescheduling_{it} = \beta_0 + \beta_1 IMF\ \widehat{Loan}_{i(t-5,t-1)} + \beta_2 IMF\ \widehat{Loan}_{i(t-5,t-1)}^{\ 2} + \beta_3 HistoricalIMFLoan_{i(1971,t-6)} + \beta_4 Controls_{it-1} + \eta_i + \tau_t + \varepsilon_{it} \quad (13)$$

The core feature of this method is that only the isolated interaction effect is used as a source of exogenous variation (Bartik, 1991; Nunn and Qian, 2014; Gehring and Lang, 2020; Lang, 2021). The constituents of the interaction term are controlled in both stages. In particular, we control for the pre-determined value of *Historical IMF Loan*. The level effect of *IMF liquidity* is controlled by year fixed effects. Conceptually, our estimation does not need to rely on the assumption that *Historical IMF Loan* and *IMF liquidity* are exogenous. The only threat to our identification is that the interaction term is not exogenous. This is very unlikely, as the omitted variables would need to have a similar time trend with *IMF liquidity* and affect the probability of debt rescheduling differently in countries with different levels of historical IMF loans (in these circumstances, the error term would be correlated with the interaction term). To demonstrate that our estimates would not suffer from such bias, Fig. 1 plots the variation in IMF liquidity with the proportion of debt rescheduling in countries with different levels of historical IMF loans. The proportions of debt rescheduling in the three groups (zero, below-median, and above-median historical IMF loans) follow a similar trend. None of the trends in those three groups is spuriously correlated with the IMF liquidity trend.

4. Empirical results

4.1. Main results

The main results of six regressions of debt rescheduling on IMF loan size are reported in Table 3. Column 1 shows the simple non-linear correlation between IMF loan size and the occurrence of debt rescheduling, relying on variation between and within countries. In column 2, we add more variables to control for the confounding factors that affect both loan amounts and the probability of debt rescheduling, thus reducing the endogeneity problem. In column 3, we further control for year-specific global shocks that affect both debt rescheduling and countries' IMF loan size by including year fixed effects, while column 4 includes country fixed effects, using only variation within countries over time. Column 5 takes into account all control variables, country fixed effects, and year fixed effects. Eliminating selection effects step by step, the results of all the OLS regressions suggest an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. The coefficient of *IMF loan* is positive and significant; the coefficient of the quadratic term is negative and significant, which supports our conjecture in Section 2.

Column 6 shows the results of our IV approach. The first-stage results are reported in the bottom panel of Table 3. For both first-stage estimations (*IMF Loan* and *IMF Loan* squared), the interaction term (instrument) is negatively significant at the 1 % level. Consistent with the previous discussion, this suggests that high IMF liquidity facilitates loan flow to countries that previously had less access to IMF loans. In addition, the quadratic interaction term (instrument) is significant in the IMF loan regression. The IV passes the under-identification test with a p-value of less than 0.001. The Kleibergen-Paap (K–P) F-statistic is 32.824, well above the rule of thumb of 10. It is also above the more conservative threshold of 16.66 proposed by Stock and Yogo (2005). The second-stage regression results still support an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. The coefficient of *IMF Loan* is positive and significant (0.570 with t-value = 4.009); the coefficient of the quadratic term is negative and significant (-0.120 with t-value = -2.712). Some researchers argue that the quadratic specification may erroneously create an extreme point, even though the true relationship is concave and monotone (Fan et al., 2019; Haans et al., 2016; Lind and Mehlum, 2010; Tan and Netessine, 2014; Benbouzid et al., 2018). Lind and Mehlum (2010) develop a method to test the U-shaped relationship. To indicate an inverted U-shaped relationship, the slope of the curve should be negative at low values and positive at high values within the interval. Analyzing the coefficients in Column 6 reveals that the inflection point is 2.38, which is within our data range. Furthermore, the test indicates that the marginal effect of IMF loans on the probability of debt rescheduling is negatively significant (p-value = 0.00) at the lower bound and positively significant (p-value = 0.04) at the upper bound. The p-values of the overall test of the presence of an inverted U-shape is 0.04, indicating that we can reject the null hypothesis that the relationship between IMF loan size and the probability of debt rescheduling is monotone or U-shaped.

4.2. Robustness checks

4.2.1. Official debt rescheduling versus private debt rescheduling

Schlegl et al. (2019) claim that official creditors may enjoy seniority to private creditors, although the claim lacks empirical evidence. If this is the case, incentives for debt rescheduling will differ between official and private creditors. In this section, we separate debt restructuring into official debt rescheduling and private debt rescheduling to check whether different creditors react differently to debtors with IMF loans. The definitions of the dependent variables (official debt rescheduling and private debt rescheduling) are listed in Table 2. The results in Table 4 show that both official and private creditors regard moderate IMF lending as a positive sign. However, once the loan exceeds a certain amount, both official and private creditors have less incentive to renegotiate the debt, given that the IMF is a *de facto* senior creditor.

The estimated coefficients from the regressions reveal an interesting contrast between official and private debt rescheduling. While the coefficients for *IMF loan* are similar in both cases, the more negative quadratic term for private debt rescheduling (-0.0857 vs.

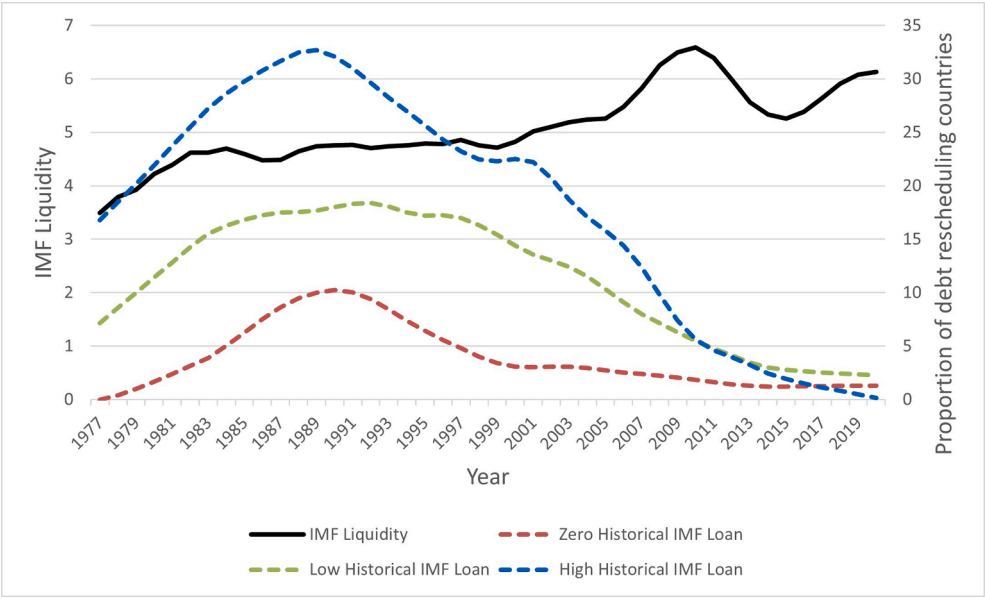

Fig. 1. IMF liquidity, historical IMF loan size and debt rescheduling trend. Note: The figure plots the proportion of debt rescheduling with the variation in IMF liquidity. The dashed lines show the proportion of debt rescheduling for countries with zero, above-median, and below-median values of historical IMF loans.

−0.0713) implies a smaller inflection point. This suggests that private creditors reach their maximum tolerance for IMF lending sooner than official creditors. As IMF lending grows, private creditors may perceive declining benefits and have less incentive to renegotiate the debt. This partially supports the conjecture proposed by Schlegl et al. (2019) that official creditors enjoy seniority over private creditors.

4.2.2. *Alternative lag structures*

In the baseline regression in Section 4.1, we use the logarithm of 1 plus the sum of the IMF loan-to-GDP ratios during the past five years to measure IMF loan size. In this section, we vary the lag structure used to measure IMF loan size. In particular, we use the logarithm of 1 plus the sum of the IMF loan-to-GDP ratios during the previous 3, 4, 6 and 7 years, respectively.[8] Table 5 shows the estimation results. For all the alternative lag structures, inverted U-shaped relationships between IMF loan size and the probability of debt rescheduling are identified. The results show that our results are robust to these alternative lag structures and do not depend on the choice of lags.

4.2.3. *Placebo tests for the instruments*

In this section, we conduct two sets of placebo tests for our instruments. First, to ensure that the IV used in this study only picks up the variation in IMF liquidity that is orthogonal to global economic cycles and rules out the influence of the global economic cycle on our first-stage estimation, we use the interactions between global economic cycle proxies and historical IMF loans as placebo IVs. In particular, we capture global financial cycles using the average global GDP growth rate for the past five years (*World GDPGROWTH*) and the total number of systemic banking crises in the past five years (*Global Bank Crisis*).[9]

Table 6 shows the estimation results; only the coefficients of instruments are reported. In columns (1) and (2), we include the global financial cycle interaction terms as control variables. The inclusion of these four interaction terms does not materially affect the first-stage coefficients of our original IVs. This shows that the IV based on *IMF Liquidity* does not pick up variation in these two measures of global economic cycle conditions. In columns (3) and (4), we use *Historical IMF Loan*World GDPGROWTH* and (*Historical IMF Loan*World GDPGROWTH)*^{2} as instruments and the other four interaction terms as control variables. In columns (5) and (6), we use *Historical IMF Loan*Global Banking Crisis* and (*Historical IMF Loan*Global Banking Crisis)*^{2} as instruments and the other four interaction terms as control variables. The results show that none of the placebo IVs are significant in the first-stage estimations and the Kleibergen-Paap F-statistics are low, indicating that the placebo IVs are not valid instruments and supporting the claim that our original IV does not pick up global economic cycles.

In order to further verify the rationality of the first-stage results, we follow Lang (2021) and perform our second placebo test. We run simulations with 1000 repetitions in which the IMF's liquidity each year is randomly assigned. Panels A and B of Fig. 2 show the

[8] The instruments need to be altered slightly. For example, for 4 years, *IMF liquidity* is defined as the average IMF liquidity during the past 4 years.
[9] Given that our variable of interest is based on a 5 year period, our proxies for global financial cycles use 5 year periods.

Table 3
Baseline results.

Estimation Method	OLS (1)	OLS (2)	OLS (3)	OLS-FE (4)	OLS-FE (5)	IV (6)	
IMF Loan	0.138***	0.109***	0.108***	0.0883***	0.0830***	0.570***	
	(7.490)	(5.909)	(5.853)	(3.624)	(3.220)	(4.009)	
(IMF Loan)^2	−0.0290***	−0.0268***	−0.0266***	−0.0201**	−0.0192**	−0.120***	
	(-3.731)	(-3.478)	(-3.405)	(-2.499)	(-2.149)	(-2.712)	
TDS		0.292***	0.204***	0.266***	0.200***	0.0699	
		(5.660)	(3.737)	(3.808)	(2.691)	(0.801)	
EDT		0.0443**	0.0386**	0.0565	0.0455	0.0102	
		(2.330)	(2.007)	(1.585)	(1.357)	(0.299)	
RES		−0.0120*	−0.00849*	−0.00796	−0.00626	−0.00494	
		(-1.883)	(-1.748)	(-1.320)	(-1.276)	(-1.532)	
CA		0.144**	0.106**	0.0699	0.0600	0.0895	
		(2.532)	(2.176)	(0.978)	(0.895)	(1.382)	
EXP		0.00785	0.00544	0.00429	0.00307	0.00189	
		(1.622)	(1.472)	(0.993)	(0.871)	(0.824)	
GDPPC		−0.0102***	−0.00383*	−0.0201***	−0.0159**	0.0105	
		(-5.749)	(-1.703)	(-4.971)	(-2.429)	(1.259)	
GDI		0.000964	0.00120	0.000318	0.000291	0.00216*	
		(1.302)	(1.623)	(0.201)	(0.183)	(1.681)	
IAR		−0.160*	−0.132	−0.159*	−0.131	0.241	
		(-1.656)	(-1.328)	(-1.736)	(-1.468)	(1.423)	
PAR		0.364***	0.356***	0.329**	0.310**	0.373***	
		(4.113)	(4.098)	(2.029)	(1.985)	(2.668)	
Historical IMF Loan						0.131*	
						(1.726)	
First Stage Results						IMF Loan	(IMF Loan)^2
Historical IMF Loan*IMF Liquidity						−0.820***	−2.001***
						(-8.465)	(-6.254)
(Historical IMF Loan*IMF Liquidity)^2						0.0121***	−0.0285
						(2.655)	(-1.425)
Country F.E.	NO	NO	NO	YES	YES	YES	
Year F.E.	NO	NO	YES	NO	YES	YES	
Obs.	2,942	2,942	2,942	2,942	2,942	2,933	
K–P underid. p						0.000	
K–P weak id. (F-statistic)						32.824	

Note: The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of IMF loans to GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All control variables have a one-year lag. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively. At the bottom of the table, we report the p-value of the Kleibergen-Paap rk LM statistic testing the null hypothesis that the excluded instruments are not correlated with the endogenous regressor and Kleibergen-Paap rk Wald F statistic testing for weak identification.

first-stage estimated coefficients of the interaction term (historical IMF loan*IMF liquidity) in the IMF loan and IMF loan squared equations, respectively.[10] The coefficients are close to a normal distribution with a mean of zero, which is clearly distinct from the actual first-stage regression result (the vertical dashed red line), thus confirming that the IV specification does not pick up any spurious trends.

4.2.4. *Alternative instruments*

Previous studies show that vote similarity to the United States in the United Nations General Assembly (UNGA) is a valid instrument for IMF programs (Barro and Lee. 2005; Steinwand and Stone, 2008; Dreher and Gassebner, 2012; Woo, 2013). In this section, we use the IV with UNGA voting similarity to the United States[11] and the results are shown in Table 7. The first-stage result shows that countries aligned with the interests of the United States are rewarded with more IMF assistance. The second-stage results confirm the inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. However, *UNGA voting* may affect the probability of sovereign debt rescheduling through channels other than IMF programs, which could violate the exclusion restriction and bias the coefficients.

4.2.5. *Using Probit estimations*

Given that our dependent variable is a dummy variable, we use Probit models in this section and the results are reported in Table 8.

[10] We do not show the results of the coefficients of (historical IMF loan*IMF liquidity),^{2} but they are available on request.
[11] We use the average of the past five years.

Table 4
Official VS. Private debt rescheduling.

	OFFICIAL (1)		PRIVATE (2)	
IMF Loan	0.360***		0.367***	
	(3.344)		(3.051)	
$(IMF\ Loan)^2$	−0.0713**		−0.0857**	
	(-2.052)		(-2.513)	
First Stage Results	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$
Historical IMF Loan*IMF Liquidity	−0.820***	−2.001***	−0.820***	−2.001***
	(-8.465)	(-6.254)	(-8.465)	(-6.254)
$(Historical\ IMF\ Loan*IMF\ Liquidity)^2$	0.0121***	−0.0285	0.0121***	−0.0285
	(2.655)	(-1.425)	(2.655)	(-1.425)
Controls	YES		YES	
Country F.E.	YES		YES	
Year F.E.	YES		YES	
Obs.	2,933		2,933	
K–P underid. p	0.000		0.000	
K–P weak id. (F-statistic)	32.824		32.824	

Note: This table examines the effects of IMF loan size on official debt rescheduling and private debt rescheduling respectively. Results are based on the baseline IV regression, but with different dependent variables. The dependent variable in column (1) is a dummy variable that takes a value of one for country-year observations in which there is an official debt rescheduling, and zero otherwise. The dependent variable in column (2) is a dummy variable that takes a value of one for country-year observations in which there is a private debt rescheduling and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of IMF loan-to-GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

Table 5
Alternative lag structures.

	Lag 3 (1)		Lag 4 (2)		Lag 6 (3)		Lag 7 (4)	
IMF Loan	0.564***		0.480***		0.395***		0.393***	
	(2.782)		(3.168)		(3.967)		(3.756)	
$(IMF\ Loan)^2$	−0.116*		−0.0846*		−0.0686**		−0.0666**	
	(-1.748)		(-1.762)		(-2.254)		(-2.170)	
First Stage Results	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$
Historical IMF Loan*IMF Liquidity	−0.354***	−0.606**	−0.595***	−1.323***	−1.041***	−2.736***	−1.210***	−3.375***
	(-3.733)	(-2.324)	(-6.179)	(-4.173)	(-11.22)	(-9.336)	(-12.39)	(-11.69)
$(Historical\ IMF\ Loan*IMF\ Liquidity)^2$	−0.00289	−0.0522**	0.00868	−0.0326	0.0183***	−0.0130	0.0238***	0.00109
	(-0.461)	(-2.389)	(1.644)	(-1.415)	(4.827)	(-0.789)	(6.157)	(0.0753)
Controls	YES		YES		YES		YES	
Country F.E.	YES		YES		YES		YES	
Year F.E.	YES		YES		YES		YES	
Obs.	2,955		2,945		2,897		2,847	
K–P underid. p	0.000		0.000		0.000		0.000	
K–P weak id. (F-statistic)	8.648		24.541		37.518		39.945	

Note: This table reports the results based on alternative lag structures. Results are based on the baseline IV regression, but with different lag structure independent variables. The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variables in columns (1) to (4) are defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-3, t-4, t-6, and t-7, respectively, to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

Column 1 shows the baseline Probit regression result. Column 2 adds year fixed effects only and column 3 adds country fixed effects only. Column 4 controls for both year fixed effects and country fixed effects. Column 5 uses an IV-probit model in which the IVs are *Historical IMF Loan*IMF Liquidity* and (*Historical IMF Loan* IMF Liquidity)*.[2] All the specifications show an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling.

4.2.6. Additional control variables

To further mitigate concerns about omitted variables, we add several sets of control variables reflecting the degree of a country's macroeconomic and institutional development. These additional variables include (1) an index of the degree of democracy (Polity IV); (2) polity characteristics including whether national elections took place during the year (Election), the number of years the

Table 6
Placebo IVs.

First Stage Results	IMF Loan (1)	(IMF Loan)^2 (2)	IMF Loan (3)	(IMF Loan)^2 (4)	IMF Loan (5)	(IMF Loan)^2 (6)
Historical IMF Loan*IMF Liquidity	−1.062***	−1.812***				
	(-7.062)	(-4.180)				
(Historical IMF Loan*IMF Liquidity)^2	0.0234**	−0.0601*				
	(2.163)	(-1.758)				
Historical IMF Loan*World GDPGROWTH			0.0392	−0.345		
			(0.221)	(-0.664)		
(Historical IMF Loan*World GDPGROWTH)^2			−0.00661	0.0833		
			(-0.288)	(1.147)		
Historical IMF Loan*Global bank crisis					−0.0628	−0.339
					(-0.597)	(-1.084)
(Historical IMF Loan*Global bank crisis)^2					−0.0310	0.0147
					(-1.539)	(0.245)
Controls	YES		YES		YES	
Country F.E.	YES		YES		YES	
Year F.E.	YES		YES		YES	
Obs.	2,933		2,933		2,933	
K–P underid. p	0.000		0.929		0.241	
K–P weak id. (F-statistic)	37.378		0.004		0.682	

Note: Results are based on the additional control variables and Placebo IVs. First-stage estimation results of 2SLS are reported. The dependent variable is either IMF loan size or IMF loan size squared, where IMF loan size is defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-5 to t-1. For columns (1) and (2), *Historical IMF Loan*IMF Liquidity* and *(Historical IMF Loan*IMF Liquidity)^2* are instruments; *Historical IMF Loan*World GDPGROWTH*, *(Historical IMF Loan*World GDPGROWTH)^2*, *Historical IMF Loan*Global bank crisis*, and *(Historical IMF Loan*Global bank crisis)^2* are control variables. For columns (3) and (4), *Historical IMF Loan*World GDPGROWTH* and *(Historical IMF Loan*World GDPGROWTH)^2* are instruments; *Historical IMF Loan*IMF Liquidity*, *(Historical IMF Loan* IMF Liquidity)^2*, *Historical IMF Loan*Global bank crisis*, and *(Historical IMF Loan*Global bank crisis)^2* are control variables. For columns (5) and (6), *Historical IMF Loan* Global bank crisis* and *(Historical IMF Loan* Global bank crisis)^2* are instruments; *Historical IMF Loan*IMF Liquidity*, *(Historical IMF Loan* IMF Liquidity)^2*, *Historical IMF Loan* World GDPGROWTH*, and *(Historical IMF Loan* World GDPGROWTH)^2* are control variables. All regressions include the standard set of control variables, as in the baseline specification of Table 3. For ease of comparison, only the coefficients and t-statistics of instruments are reported. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

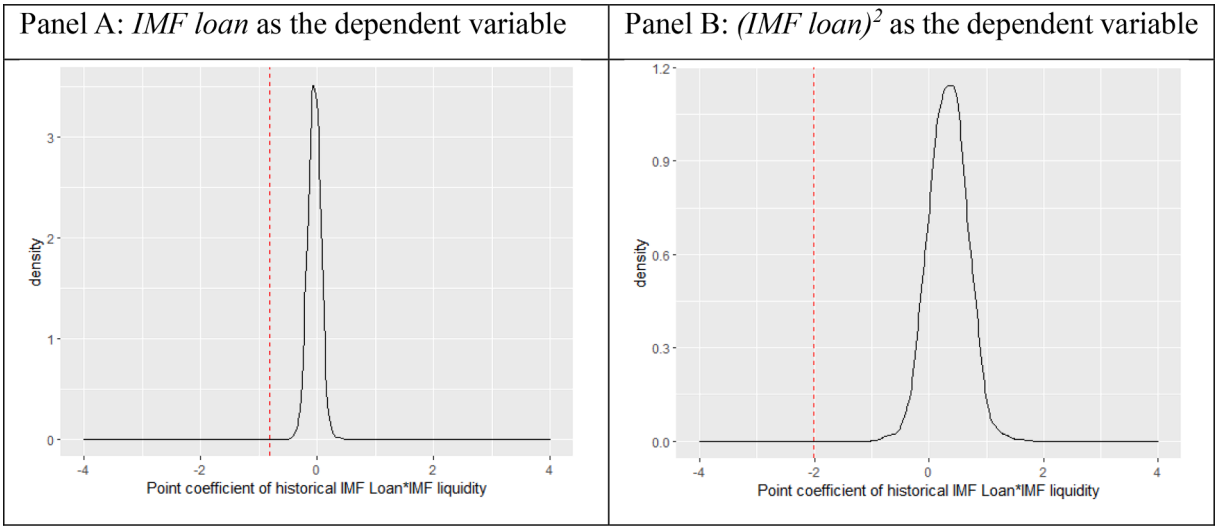

Fig. 2. First-stage coefficient of historical IMF loan*IMF liquidity: Randomizing Liquidity.

government has been in power (Honeymoon), and whether the ruling party's ideology is left-leaning (Left); (3) an index of access to sound money (Soundmoney); (4) an index of political, financial, and economic riskiness (RiskRating); and (5) the degree of capital account openness (Financial openness). The results in Table 9 show that the inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling is robust to the inclusion of many additional control variables.

4.2.7. Subsample analysis

Table 10 reports the results of the subsample analysis. Several rounds of sovereign debt rescheduling can happen within a few years,

Table 7
Alternative IV.

	Debt Rescheduling	
IMF Loan	0.337**	
	(2.154)	
$(IMF\ Loan)^2$	−0.178***	
	(-2.792)	
First Stage Results	IMF Loan	$(IMF\ Loan)^2$
UNGA voting	0.389***	1.229***
	(6.426)	(6.948)
$(UNGA\ voting)^2$	−0.0437	0.254**
	(-1.066)	(2.243)
Controls	YES	
Country F.E.	YES	
Year F.E.	YES	
Obs.	2,895	
K–P underid. p	0.000	
K–P weak id. (F-statistic)	29.964	

Note: Results are based on an alternative IV, which is UNGA voting similarity to the United States. The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. The regression includes the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

Table 8
Probit Model.

	Probit (1)	Probit (2)	Probit (3)	Probit (4)	IV-Probit (4)
IMF Loan	0.745***	0.748***	0.611***	0.538***	2.360***
	(6.945)	(6.750)	(4.709)	(3.909)	(7.548)
$(IMF\ Loan)^2$	−0.188***	−0.184***	−0.143***	−0.120**	−0.435***
	(-4.808)	(-4.478)	(-3.201)	(-2.512)	(-3.248)
Controls	YES	YES	YES	YES	YES
Country F.E.	No	No	YES	YES	YES
Year F.E.	No	YES	No	YES	YES
Obs.	2,942	2,745	2,105	1,970	1,965

Note: Results are based on the Probit model. The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

while economic conditions may improve after debt rescheduling (Reinhart and Trebesch, 2016) and affect the involvement of the IMF, leading to a post-rescheduling bias. To minimize the impact of feedback effects of sovereign debt rescheduling on future IMF loan size, we exclude country-year observations three years after sovereign debt rescheduling in column (1). The debtor country's income level may affect the outcome of the sovereign debt rescheduling (Das et al., 2012), thus we exclude high-income countries in column (2) and exclude low-income countries in column (3). Countries that have never received a loan from the IMF may differ substantially from countries that have received at least one loan, thus we exclude countries that have not received a loan from the IMF during our sample period in column (4). Following the same logic, in column (5) we exclude countries that have not rescheduled their sovereign debt during our sample period. All the results in Table 10 indicate an inverted U-shaped relationship between IMF loan size and the probability of sovereign debt rescheduling.

4.3. Additional analysis

4.3.1. The role of debtor commitment

Our theory posits that an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling stems from the effort choices of debtors and creditors. In this section, we analyze the role of debtor commitment. Among different IMF programs, PRGTs should be viewed as foreign aid and are concessional loans (Barro and Lee, 2005). The conditionality attached to PRGT loans is

Table 9
Additional Control Variables.

	(1)		(2)		(3)		(4)		(5)	
IMF Loan	0.528***		0.560***		0.671***		0.681***		0.554***	
	(3.825)		(4.037)		(3.922)		(3.453)		(3.691)	
(IMF Loan)^2	−0.114***		−0.117***		−0.171***		−0.142**		−0.111**	
	(-2.642)		(-2.701)		(-2.953)		(-2.521)		(-2.466)	
Polity IV	−0.00196									
	(-0.853)									
Left government			0.00706							
			(0.300)							
Election			0.00367							
			(0.209)							
Honeymoon			0.00390***							
			(2.923)							
Soundmoney					−0.0083					
					(-1.022)					
RiskRating							0.00245			
							(0.841)			
Financial openness									0.0398	
									(0.879)	
First Stage Results	IMF Loan	(IMF Loan)^2	IMF Loan	(IMF Loan)^2	IMF Loan	(IMF Loan)^2	IMF Loan	(IMF Loan)^2	IMF Loan	(IMF Loan)^2
Historical IMF Loan*IMF Liquidity	−0.942***	−2.333***	−0.849***	−2.061***	−0.688***	−1.244***	−0.856***	−2.305***	−0.807***	−2.037***
	(-9.178)	(-6.934)	(-8.605)	(-6.316)	(-5.207)	(-3.439)	(-6.657)	(-4.997)	(-7.911)	(-6.059)
(Historical IMF Loan*IMF Liquidity)^2	0.0142***	−0.0237	0.0133***	−0.0264	0.0118*	−0.0366	0.0171***	−0.0144	0.0127***	−0.0247
	(3.041)	(-1.175)	(2.892)	(-1.316)	(1.787)	(-1.631)	(3.034)	(-0.548)	(2.676)	(-1.202)
Controls	YES		YES		YES		YES		YES	
Country F.E.	YES		YES		YES		YES		YES	
Year F.E.	YES		YES		YES		YES		YES	
Obs.	2,701		2,865		2,473		1,991		2,814	
K–P underid. p	0.000		0.000		0.000		0.000		0.000	
K–P weak id. (F-statistic)	31.166		35.135		16.916		18.866		27.695	

Note: This table reports results with additional control variables. Results are based on the baseline IV regression, but with additional control variables. Definitions of additional control variables are provided in Table 2. The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

Table 10
Subsample Analysis.

	Exclude post-rescheduling periods (1)		Exclude high-income countries (2)		Exclude low-income countries (3)		Countries with at least one IMF support (4)		Countries with at least one rescheduling (5)	
IMF Loan	1.080*		0.653***		0.733***		0.571***		0.903***	
	(1.857)		(4.329)		(3.056)		(3.878)		(3.389)	
$(IMF\ Loan)^2$	−0.363*		−0.133***		−0.190**		−0.119***		−0.184***	
	(-1.665)		(-2.907)		(-2.076)		(-2.663)		(-2.711)	
First Stage Results	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$	IMF Loan	$(IMF\ Loan)^2$
Historical IMF Loan*IMF Liquidity	−0.677***	−1.686***	−0.726***	−1.705***	−0.824***	−1.884***	−0.844***	−2.107***	−0.677***	−1.909***
	(-5.186)	(-4.483)	(-7.382)	(-5.027)	(-7.973)	(-5.946)	(-8.244)	(-6.276)	(-5.186)	(-4.259)
$(Historical\ IMF\ Loan*IMF\ Liquidity)^2$	0.00547	0.0181	0.00911*	−0.0376*	0.0183***	0.00798	0.0128***	−0.0256	0.00547	−0.0341
	(0.982)	(0.634)	(1.947)	(-1.777)	(3.455)	(0.369)	(2.749)	(-1.269)	(0.982)	(-1.420)
Controls	YES		YES		YES		YES		YES	
Country F.E.	YES		YES		YES		YES		YES	
Year F.E.	YES		YES		YES		YES		YES	
Obs.	2,310		2,894		2,526		2,811		2,215	
K–P underid. p	0.000		0.000		0.000		0.000		0.000	
K–P weak id. (F-statistic)	1.856		30.303		4.730		29.353		11.858	

Note: This table reports results of subsample analysis. Results are based on the baseline IV regression, but with different samples. In column (1), post-rescheduling periods are excluded. In column (2), high-income countries are excluded. In column (3), low-income countries are excluded. In column (4), the sample consists of countries with at least one IMF support. In column (5), the sample consists of countries with at least one rescheduling. The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

less stringent.[12] This implies that debtors face fewer policy reform requirements and make weaker commitments when receiving PRGT loans. If debtor commitment plays an important role for successful debt renegotiation, we would expect significant effects of non-PRGT IMF loans on debt rescheduling probability, with PRGT loans having negligible impact. Columns (1) and (2) of Table 11 report the regression results of non-PRGT and PRGT loans, respectively. A significant inverted U-shaped relationship exists between non-PRGT loans and the probability of debt rescheduling, while IMF loan terms are insignificant for PRGT loans. The results provide evidence that debtor commitment may affect the probability of debt rescheduling.

IMF loans are paid out in tranches over time, when the debtor government meets specific reform milestones. Although we cannot directly observe the commitment of the debtor, if a large percentage of the agreed IMF loan remains undrawn, this indicates the non-compliance of the debtor. Following Dreher and Walter (2010), when more than 25 % of the agreed IMF loan remains undrawn at program expiration, it is classified as non-compliance. Columns (3) and (4) of Table 11 report the regression results for compliance loans and non-compliance loans, respectively. There is a significant inverted U-shaped relationship between compliance loans and the probability of debt rescheduling, while IMF loan terms are insignificant for non-compliance loans. These results underscore the importance of debtor commitment.

4.3.2. IMF loans and creditor commitment

As discussed previously, coordination problems among creditors are a major challenge for debt rescheduling. One way to mitigate coordination problems is to form a creditor committee. Creditors on the committee are responsible for obtaining cooperation from other creditors not represented on the committee. The committee has decision power over the terms of restructuring (Asonuma and Joo, 2020). While we cannot directly observe creditor effort, we can proxy creditor commitment using a creditor committee. We use the creditor committee dataset compiled by Asonuma and Joo (2020) in this section. This dataset only includes creditor committee information for private debt rescheduling. Ideally, comprehensive creditor committee data covering both private and official debt rescheduling is needed. However, creditor committee information for official debt rescheduling is not available. Official debt rescheduling usually takes place at the Paris Club, and the members of the Paris Club can be viewed as a committee. For official creditors who are not members of the Paris Club (e.g. China, India, Turkey and Saudi Arabia), a creditor committee may be needed. Intuitively, the coordination problem among private creditors is more severe. The analysis of the relationship between IMF loans and creditor committees of private creditors may shed light on how the IMF can facility debt rescheduling. In column (1) of Table 12, we define the dependent variable *creditor committee* as a dummy that takes a value of one for country-year observations in which there is a debt rescheduling with a creditor committee. A creditor committee normally comprises a group of between 5 and 20 representative creditors. In column (2) of Table 12, we define the dependent variable *creditor committee chair* as a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling with a creditor committee chair. The creditor committee chair is usually the debtor's largest creditor or the creditor who chaired the last debt negotiation. For both regressions, the coefficients of *IMF loan* are positively significant, and the coefficients of the quadratic terms are negatively significant. The results show an inverted U-shaped relationship between IMF loan size and the probability of forming a creditor committee or having a creditor committee chair. This implies that IMF involvement initially encourages creditor coordination, but excessive IMF loans disincentivize renegotiation due to diminishing potential surpluses.

5. Conclusion

Previous studies have found that participation in IMF programs can facilitate sovereign debt rescheduling (Marchesi, 2003). However, the role of IMF loan size is overlooked. Given the importance of IMF loan size to the debtor country's economy (Krahnke, 2023, Papi et al., 2015), this study fills a gap by investigating the effect of IMF loan size on the probability of sovereign debt rescheduling. We develop a theoretical model to explain the possible inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. The model highlights incentive problems faced by debtors and creditors during debt rescheduling renegotiation. Given that the IMF is a *de facto* senior creditor, borrowing too much from the IMF leaves a smaller total surplus for the debtor and creditor to share in the future, so both parties have less incentive to renegotiate the debt.

Empirically, we adopt a new identification strategy to isolate the effect of IMF loan size. Our identification strategy is based on a Bartik-style IV that combines changes in the IMF's liquidity and the country's historical average loan size. Using annualized panel data from 100 countries over the period from 1977 to 2020, we find that the probability of debt rescheduling is positively associated with IMF loan size and negatively associated with the square term of IMF loan size. This indicates an inverted U-shaped relationship between IMF loan size and the probability of debt rescheduling. Our results are robust to various estimation strategies (OLS, fixed effect model, IV regression and probit regression), different types of creditors, different lag structures, alternative instruments, and different subsamples. Our findings add to the debate on the effectiveness of IMF programs in helping countries in crisis. While our results confirm the positive role of IMF lending in resolving sovereign debt crises, the unintended adverse outcomes of too much lending should also be noted.

[12] For further information, please read International Monetary Fund (2023b) and "IMF Lending to Poor Countries – How does the PRFG differ from the ESAF?" at https://www.imf.org/external/np/exr/ib/2001/043001.htm.

Table 11
The role of debtor commitment.

	Non-PRGT loan (1)		PRGT loan (2)		Compliance loan (3)		Non-compliance loan (4)	
IMF Loan	0.984**		−0.115		0.413***		0.645	
	(2.173)		(-0.560)		(3.678)		(0.919)	
(IMF Loan)2	−0.331*		0.105		−0.102**		−0.230	
	(-1.825)		(1.233)		(-2.432)		(-0.615)	
First Stage Results	IMF Loan	$(IMF Loan)^2$	IMF Loan	$(IMF Loan)^2$	IMF Loan	$(IMF Loan)^2$	IMF Loan	$(IMF Loan)^2$
Historical IMF Loan*IMF Liquidity	−1.031***	−2.384***	−1.104***	−2.202***	−1.013***	−2.094***	−0.962***	−1.842***
	(-9.915)	(-7.715)	(-6.889)	(-5.362)	(-7.568)	(-6.030)	(-6.780)	(-4.679)
(Historical IMF Loan*IMF Liquidity)^2	0.00182	−0.0255	0.0404***	0.0176	0.0170	−0.0601*	0.0428***	0.0734***
	(0.300)	(-1.088)	(2.780)	(0.458)	(1.599)	(-1.666)	(5.791)	(3.000)
Controls	YES		YES		YES		YES	
Country F.E.	YES		YES		YES		YES	
Year F.E.	YES		YES		YES		YES	
Obs.	2,933		2,933		2,935			
K–P underid. p	0.000		0.000		0.000		0.447	
K–P weak id. (F-statistic)	2.671		18.986		29.919		0.267	

Note: This table examines the role of debtor commitment. Results are based on the baseline IV regression. IMF loans are divided into two groups, PRGT and Non-PRGT, as well as compliance and non-compliance, to identify the role of debtor commitment. The dependent variable is a dummy variable that takes a value of one for country-year observations in which there is a debt rescheduling (either official debt rescheduling or private debt rescheduling), and zero otherwise. The independent variable of column (1) is defined as the logarithm of one plus the sum of the non-PRGT IMF loan-to-GDP ratios of country i from year t-5 to t-1. The independent variable of column (2) is defined as the logarithm of one plus the sum of the PRGT IMF loan-to-GDP ratios of country i from year t-5 to t-1. The independent variable of column (3) is defined as the logarithm of one plus the sum of the compliance IMF loan-to-GDP ratios of country i from year t-5 to t-1. The independent variable of column (4) is defined as the logarithm of one plus the sum of the non-compliance IMF loan-to-GDP ratios of country i from year t-5 to t-1. Among them, non-PRGT and compliance represent a greater extent of debtor commitment. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

Table 12
IMF loan and creditor commitment.

	Creditor Committee (1)		Creditor Committee Chair (2)	
IMF Loan	0.369***		0.326***	
	(3.019)		(2.750)	
(IMF Loan)2	−0.0960***		−0.0840**	
	(-2.782)		(-2.527)	
First Stage Results	IMF Loan	$(IMF Loan)^2$	IMF Loan	$(IMF Loan)^2$
Historical IMF Loan*IMF Liquidity	−0.820***	−2.001***	−0.820***	−2.001***
	(-8.465)	(-6.254)	(-8.465)	(-6.254)
(Historical IMF Loan*IMF Liquidity)^2	0.0121***	−0.0285	0.0121***	−0.0285
	(2.655)	(-1.425)	(2.655)	(-1.425)
Controls	YES		YES	
Country F.E.	YES		YES	
Year F.E.	YES		YES	
Obs.	2,933		2,933	
K–P underid. p	0.000		0.000	
K–P weak id. (F-statistic)	32.824		32.824	

Note: This table examines the effect of IMF loans on creditor commitment. Results are based on the baseline IV regression, but with different dependent variables. The dependent variable in column (1) is a dummy variable that takes the value of one for country-year observations in which there is a debt rescheduling with creditor committee, and zero otherwise. The dependent variable in column (2) is a dummy variable that takes the value of one for country-year observations in which there is a debt rescheduling with creditor committee chair, and zero otherwise. The independent variable is IMF loan size, defined as the logarithm of one plus the sum of the IMF loan-to-GDP ratios of country i from year t-5 to t-1. To explore the non-linear relationship, the quadratic of IMF Loan is also included. All regressions include the standard set of control variables, as in the baseline specification of Table 3. The table reports the regression coefficients and, in parentheses, t-statistics based on robust standard errors. ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

CRediT authorship contribution statement

Ye Bai: Investigation, Methodology, Resources, Supervision, Writing – review & editing. **Sanjay Banerji:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. **Zilong Wang:** Conceptualization, Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft. **Wenjing Zhang:** Data curation, Formal analysis, Methodology, Software, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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